



NORTH CAROLINA
Turnpike Authority

Maintenance Rating Program

Triangle Expressway

2015 Third Quarter Report

1 S. Wilmington Street
Raleigh, NC 27601



Last Updated:
October 21, 2015

CONSULTANT CERTIFICATION OF COMPLETION

October 16, 2015

Mr. Andy Lelewski, PE
NCTA Director of Toll Road Operations
1 South Wilmington Street
Raleigh, NC 27601

NCTA Triangle Expressway Roadway and Facility Maintenance Performance Rating Program

This is to certify that I, Ken M. McEntire, PE am an authorized official representative of the company Asset Management Associates, PLLC, which is a subconsultant to HNTB North Carolina, P.C. Collaboratively, we are working as the Triangle Expressway Roadway and Facility Maintenance Performance Rating Program Consultants.

I know of my own personal knowledge, and do hereby certify, that the work of the contract described above has been independently performed in accordance with, and in conformity to, the *NCTA Roadway and Facility Maintenance Performance Standards*.

Sincerely,

A handwritten signature in blue ink that reads "Ken M. McEntire". The signature is written in a cursive style with a large initial "K" and "M".

Ken M. McEntire, PE

Asset Management Associates, PLLC
126 North Salem Street, Suite 203
Apex, NC 27502

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1.0 EXECUTIVE SUMMARY

The North Carolina Turnpike Authority (NCTA) Maintenance Rating Program (MRP) is a maintenance evaluation program for roadway features and toll facilities on the NCTA system. This report presents results from the 2015 Third Quarter Assessment of the Triangle Expressway.

The overall 2015 third quarter maintenance rating of the Triangle Expressway is 93.1, which is above the NCTA target rating of 90. As shown in **Table 1**, all elements assessed achieved a rating greater than the target rating of 85.

TABLE 1: MRP ELEMENT RESULTS FOR THE 2015 THIRD QUARTER ASSESSMENT		
ELEMENT	MRP Rating	Target Rating
Road Surface	98.9	85.0
Unpaved Shoulders	100.0	85.0
Drainage	93.5	85.0
Roadside	86.3	85.0
Traffic Control Devices	89.0	85.0
Overall MRP Performance Rating	93.1	90.0

As part of the NCTA MRP, this report provides a rolling rating of the latest four quarterly inspections of the Triangle Expressway. As presented in **Table 2**, the current rolling maintenance rating of the Triangle Expressway is 92.0.

TABLE 2: MRP ROLLING ELEMENT RESULTS					
ELEMENT	Q4 2014 RATING	Q1 2015 RATING	Q2 2015 RATING	Q3 2015 RATING	ROLLING RATING
Road Surface	93	99	98	99	98
Unpaved Shoulders	95	100	97	100	98
Drainage	83	93	93	94	91
Roadside	83	88	87	86	86
Traffic Control Devices	82	84	97	89	88
Overall MRP Performance Rating	86.8	92.0	94.7	93.1	92.0

In addition, the report provides findings of the Green Level Historic District signs inspections. This quarter, all Green Level Historic District signs were found to be in good physical condition, and the landscaped areas around the signs were well maintained.

2.0 INTRODUCTION

The NCTA MRP is a comprehensive planning, measuring, and managing process that provides a means for communicating to managers, stakeholders and customers the impacts of policy and budget decisions on program service delivery.

Using outcome-based performance measures and the service level scale (0 through 100), the inspection results are rated against established thresholds criteria. The program analysis is accomplished through the use of sampling procedures that capture the level of service being provided for individual assets. The evaluation procedure is based on the establishment of threshold conditions that quantify the maximum defect allowed on assets. Over time, the results can be charted to identify work needs and subsequent necessary actions.

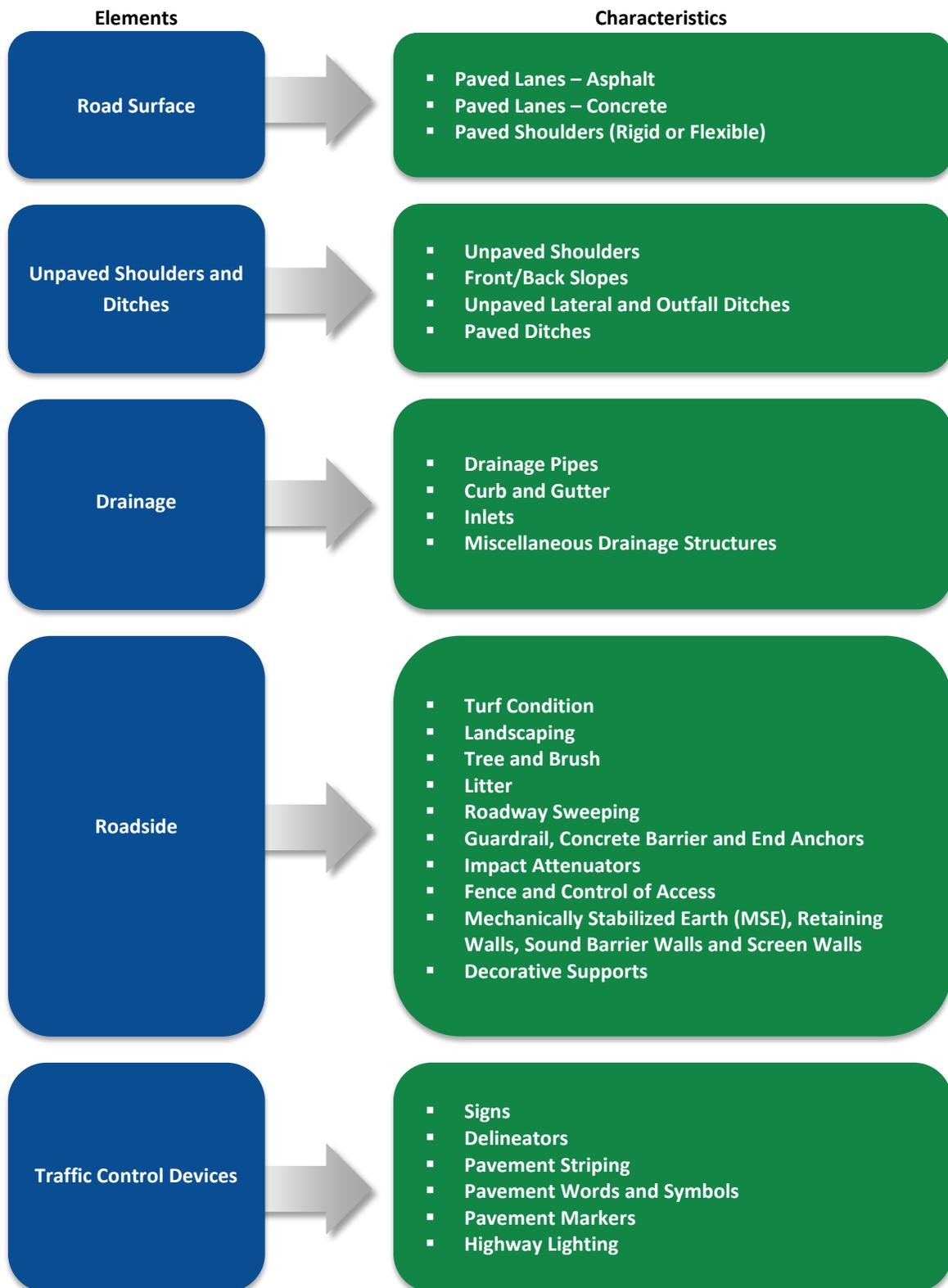
The NCTA performance standards, threshold criteria and maintenance rating program were developed through a collaborative effort by NCTA managers, NCDOT maintenance staff and consultants.

Using field survey information, a maintenance matrix can be developed to show the ties between maintenance activities and the characteristics of various roadway features. The purpose of this evaluation is to provide information that can be used to schedule and prioritize routine maintenance activities and provide uniform maintenance conditions that meet established objectives.

3.0 MRP PROCEDURE

Per the *NCTA Roadway and Facility Maintenance Performance Standards V4*, roadway assets or characteristics on NCTA facilities have been grouped into elements. These elements and corresponding characteristics can be seen in **Figure 1**:

Figure 1: Maintenance Elements and Characteristics



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A weighting system has been established to identify the importance of each element and characteristic. This system consists of two weighting factors: one that accounts for the importance of individual characteristics within a given maintenance element (1-9), and one that accounts for the importance of the maintenance elements to the total rating (by % of score). This two-factor system reveals deficiencies among characteristics and elements.

The program analysis is accomplished through the use of statistically valid, random sampling procedures that capture the level of service for individual characteristics with a 95% confidence level in sampling. The sample characteristics selected are evaluated during quarterly inspections, which are performed during the months of February, May, August, and November to account for dynamic changes in assets during the various seasons. The evaluation process is completed using electronic data collection tablets and is based on established threshold conditions described in the *NCTA Roadway and Facility Maintenance Standards V4*. Those characteristics that meet or exceed the threshold are coded as PASSING; those that do not meet the threshold are coded as NOT PASSING.

When the evaluation process is completed, the number of PASSING samples and total sample are multiplied by the weighted values (1-9) to determine the actual and possible rating points for characteristics and elements. MRP ratings for elements and characteristics are then calculated as the ratio of the actual rating points to possible rating points. The MRP ratings represent the maintenance level of service currently being provided, as they define the percent of characteristics and elements that meet the maintenance condition standard. For instance, a MRP rating of 83 signifies that 83 percent of the inspected elements/characteristics met the standard.

The overall MRP rating is determined by summing the elements MRP rating multiplied by the following weighted factors:

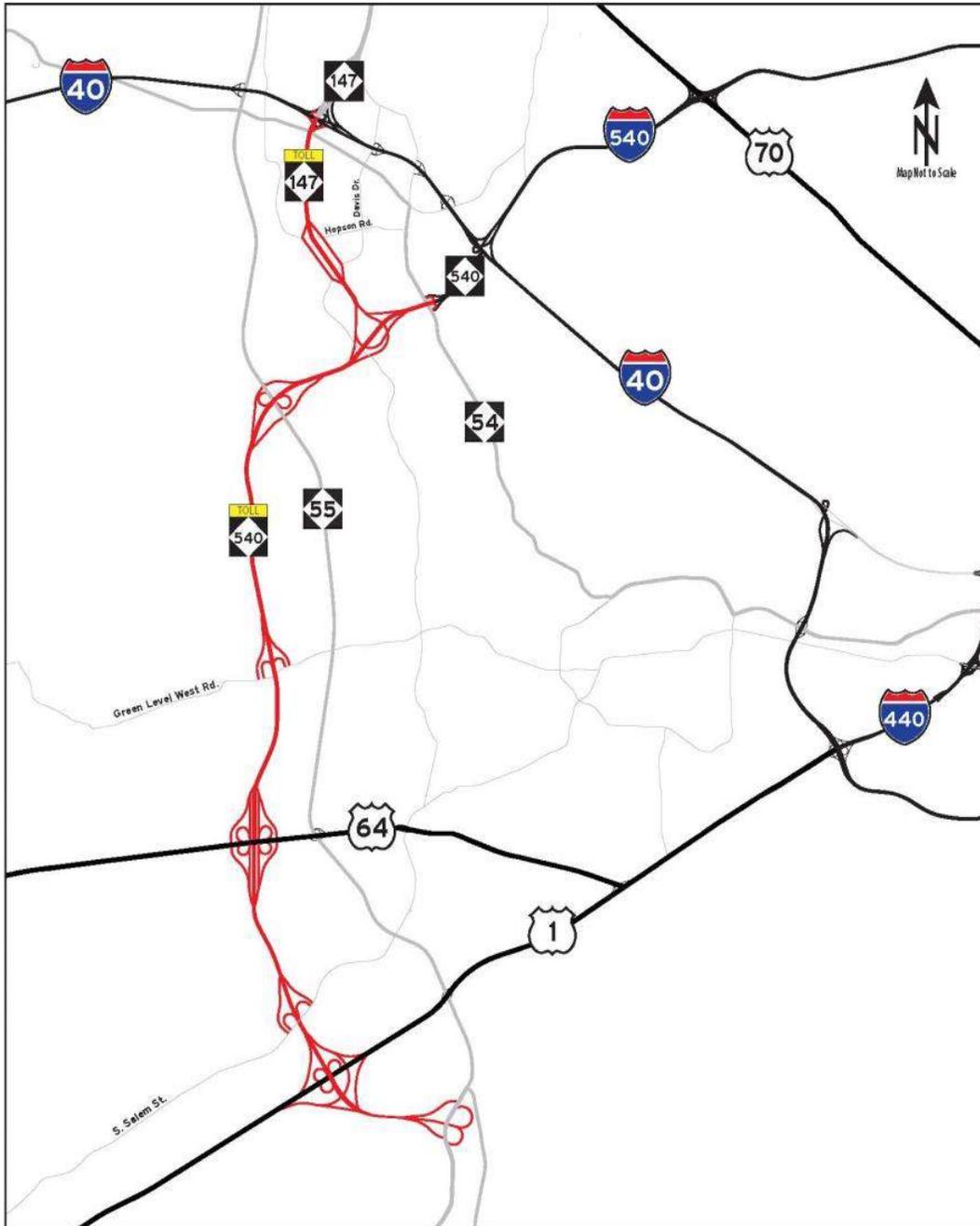
Road Surface =	25%
Unpaved Shoulders =	13%
Drainage =	15%
Roadside =	17%
Traffic Control Devices =	30%
<hr/>	
Total	100%

The NCTA's overall target rating is 90, with elements scoring 85 or higher, and characteristics 80 or higher. In addition to quarterly ratings, the cumulative rolling annual rating is calculated each quarter. This rating is obtained by adding the ratings of the latest four quarterly inspections to compensate for the likelihood of uneven sample sizes.

4.0 TRIANGLE EXPRESSWAY DESCRIPTION

The Triangle Expressway extends for approximately 18.8 miles from the interchange of I-40 and NC-147 in Durham to the NC-55 Bypass near Holly Springs (*Figure 2*). It includes a one-mile segment on NC-540 extending north from the NC-540 / NC-147 interchange to the NC-54 interchange. The Triangle Expressway consists of ten interchanges and eighteen all-electronic toll collection zones.

Figure 2: Triangle Expressway Map



5.0 TRIANGLE EXPRESSWAY ASSET INVENTORY UPDATE

Through normal day-to-day maintenance activities and the construction of special projects, roadside assets are continuously being added or modified on the roadway. NCTA coordinates closely with NCDOT Division Maintenance and conducts routine field visits to maintain an accurate asset inventory and ensure the validity of the MRP.

During the third quarter no assets were removed or added to the inventory.

6.0 MRP ASSESSMENT

6.1 Quarterly Results

The overall 2015 third quarter maintenance rating of the Triangle Expressway is 93.1, and is above the overall target rating of 90. All element ratings are above the target rating of 85. Turf (47), Retaining, Sound and Screen Walls (79), Delineators (76), and Highway Lighting (67) are the characteristics that scored below the target rating of 80. It is important to note that these results are only representative of the third quarter sample, one of the four surveys to provide an intermediate snapshot of seasonal conditions. Therefore, they are not a statistically valid representation of the assets; only the total of all four quarterly inspections, reported at the end of each calendar year, will provide a 95% confidence level in statistical sampling. The third quarter MRP performance ratings for elements and characteristics are presented in **Table 3** and **Table 4**, respectively.

TABLE 3: MRP ELEMENT RESULTS FOR Q3 2015	
ELEMENT	Q3 2015 MRP Rating
Road Surface	98.9
Unpaved Shoulders	100.0
Drainage	93.5
Roadside	86.3
Traffic Control Devices	89.0
Overall MRP Performance Rating	93.1

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TABLE 4: MRP CHARACTERISTIC RESULTS FOR Q3 2015						
ROAD SURFACE	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q3 RATING
Paved Lanes Asphalt	52	52	9	468	468	100
Paved Lanes Concrete	64	64	9	576	576	100
Paved Shoulders	55	58	5	275	290	95
Element Total				1324	1334	99.3
UNPAVED SHOULDERS AND DITCHES	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q3 RATING
Unpaved Shoulders	58	58	9	522	522	100
Front/Back Slopes	58	58	6	348	348	100
Lateral and Outfall Ditches, Unpaved	58	58	6	348	348	100
Paved Ditches	2	2	5	10	10	100
Element Total				1228	1228	100.0
DRAINAGE	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q3 RATING
Drainage Pipes	31	34	7	217	238	91
Curb and Gutter	23	25	6	138	150	92
Inlets	34	34	7	238	238	100
Misc. Drainage Structures	28	32	4	112	128	88
Element Total				705	754	93.5
ROADSIDE	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q3 RATING
Turf Condition	35	74	7	245	518	47
Landscaping	32	32	4	128	128	100
Trees and Brush	31	31	4	124	124	100
Litter	58	58	4	232	232	100
Roadway Sweeping	57	58	5	285	290	98
Guardrails and Concrete Barriers	29	30	9	261	270	97
Impact Attenuators	8	9	9	72	81	89
Fence and Control Access	29	29	7	203	203	100
Retaining, Sound and Screen Walls	15	19	5	75	95	79
Decorative Supports	25	25	5	125	125	100
Graffiti and Stain Removal	59	59	4	236	236	100
Element Total				1986	2302	86.3
TRAFFIC CONTROL DEVICES	SAMPLE PASSED	SAMPLE TOTAL	WEIGHTED VALUES	ACTUAL PTS	AVAILABLE PTS	Q3 RATING
Signs	33	33	7	231	231	100
Delineators	34	45	3	102	135	76
Pavement Striping/Marking	56	58	8	448	464	97
Words and Symbols	28	30	7	196	210	93
Pavement Markers	50	58	9	450	522	86
Highway Lighting	18	27	6	108	162	67
Element Total				1520	1724	89.0

Additionally, **Appendix A** shows maps of all the assets that were assessed during the third quarter. **Appendix B** shows a list of the individual assets that failed the MRP.

6.2 Analysis and Recommendations

Elements

During the third quarter all elements exceeded NCTA's target threshold criteria of 85. However, the third quarter rating for Traffic Control Devices (89.0) is 7.8 points lower than the second quarter rating (96.8). While still an improvement from the first quarter (84.4), the maintenance provider should continue to monitor closely those characteristics that caused the Traffic Control Devices rating to decrease; for this reporting period, these characteristics are listed below.

- Delineators (76), 24 points lower than the second quarter rating (100)
- Highway Lighting (67), 29 points lower than the second quarter rating (96)
- Pavement Markers (86), 9 points lower than the second quarter rating (95)

Characteristics

This quarter all characteristics satisfied the NCTA target threshold criteria of 80 with the exception of Turf Condition (47), Retaining Wall and Sound Barrier Wall (79), Delineators (76), and Highway Lighting (67). This section describes conditions of these characteristics and presents recommended future work planning to raise the ratings. Pictures of the failures are included in **Appendix B**.

Turf Condition (47 rating – 39 of the 74 assets failed). Out of the 74 turf areas inspected, 39 failed due to bare ground. Two of the failing turf areas can be seen in the **Figure 3**.

Figure 3: Turf Failures



As per the NCDOT Division 5 Landscape Unit Plan presented during the second quarter, the hydro-seeding process of a selected bare ground area with warm season grasses began during the third quarter. Also, all turf areas along the facility were fertilized. As of this report, no positive results from these efforts have been observed and ratings continue to drop. However, it is important to recognize that results from these efforts may not be immediate as it may take several years for the turf to be fully established.

The NCDOT Division 5 Landscape Unit continues to monitor turf bare ground areas and is working closely with the Roadside Environmental staff to determine an effective treatment for these areas. The unit is also planning two more fertilization treatments during May and August of 2016. Future MRP assessments will continue to track the progress of the program and its effectiveness.

Retaining, Sound and Screen Walls (79 rating – 4 of the 19 assets failed). Wall failures were related to paint scaling and joint separation. Two of the failing walls are presented in *Figure 4*.

Figure 4: Retaining, Sound and Screen Wall Failures

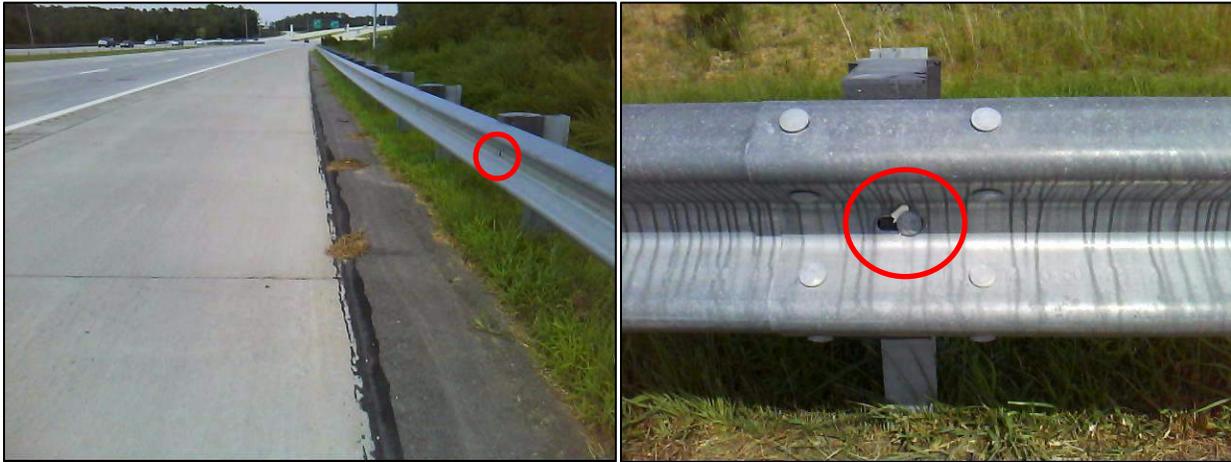


In order to avoid further deterioration of these walls, it is recommended that the maintenance provider paint all wall sections experiencing paint scaling, especially those sections painted white.

The joint failures are likely caused by settlement of backfill material (usually wash stone) below the cap plate, and between the sound wall and the concrete barrier wall. These repairs should fall within the warranty of workmanship clause from the original construction. Otherwise, it is recommended that repairs take place by removing the cap and replacing backfill material compacted in 6 inch layers.

Delineators (76 rating – 11 of the 45 assets failed). Of the 11 linear segments that failed due to delineators, 10 failed because of missing delineators and 1 failed due to lack of reflectivity. Two of the failing linear segments due to delineators are presented in *Figure 5*.

Figure 5: Delineator Failures



It is thought that the automated mowing equipment utilized to trim underneath guardrails may be damaging or removing guardrail delineators. Therefore, it is recommended that guardrail delineators be replaced and that mowing activities be closely monitored to avoid the removal or damage of delineators.

Highway Lighting (67 rating – 9 of the 27 assets failed). All 9 highway lighting failures were due to functional damage and were observed during the nighttime inspection south of US 64. These failures were found to be due to a burned splice connector in one of the junction boxes in the median. The connector was repaired 10 days after the failure occurred.

7.0 ROLLING MRP RATING

The current rolling maintenance rating of the Triangle Expressway is 92.0, exceeding NCTA's target overall rating of 90. Additionally, all element ratings are above the target rating of 85. All but three characteristics' ratings meet or exceed the target rating of 80. Ratings for Miscellaneous Drainage Structures, Turf Condition and Pavement Markers were 74, 49 and 78, respectively.

The cumulative rolling results are presented in **Tables 5 and 6**. These results are a collection of the four latest quarterly inspections.

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TABLE 5: MRP ROLLING CHARACTERISTIC RESULTS					
ROAD SURFACE	Q4 2014 RATING	Q1 2015 RATING	Q2 2015 RATING	Q3 2015 RATING	ROLLING RATING
Paved Lanes Asphalt	100	100	100	100	100
Paved Lanes Concrete	94	100	100	100	99
Paved Shoulders	87	97	93	95	94
Element Total	93.3	98.8	97.6	99.3	98.0
UNPAVED SHOULDERS AND DITCHES	Q4 2014 RATING	Q1 2015 RATING	Q2 2015 RATING	Q3 2015 RATING	ROLLING RATING
Unpaved Shoulders	94	100	97	100	98
Front/Back Slopes	97	100	95	100	98
Lateral and Outfall Ditches, Unpaved	94	100	98	100	99
Paved Ditches	100	100	100	100	100
Element Total	94.6	100.0	96.6	100.0	98.2
DRAINAGE	Q4 2014 RATING	Q1 2015 RATING	Q2 2015 RATING	Q3 2015 RATING	ROLLING RATING
Drainage Pipes	97	94	88	91	93
Curb and Gutter	84	100	96	92	93
Inlets	88	97	97	100	96
Misc. Drainage Structures	32	75	94	88	74
Element Total	82.5	93.0	93.4	93.5	90.7
ROADSIDE	Q4 2014 RATING	Q1 2015 RATING	Q2 2015 RATING	Q3 2015 RATING	ROLLING RATING
Turf Condition	46	54	50	47	49
Landscaping	81	97	91	100	93
Trees and Brush	100	100	100	100	100
Litter	100	98	100	100	100
Roadway Sweeping	81	98	98	98	96
Guardrails and Concrete Barriers	100	100	97	97	98
Impact Attenuators	100	100	100	89	97
Fence and Control Access	97	100	90	100	97
Retaining, Sound and Screen Walls	88	79	95	79	85
Decorative Supports	96	96	100	100	98
Graffiti and Stain Removal	97	100	100	100	100
Element Total	83.2	88.1	86.6	86.3	86.2
TRAFFIC CONTROL DEVICES	Q4 2014 RATING	Q1 2015 RATING	Q2 2015 RATING	Q3 2015 RATING	ROLLING RATING
Signs	94	100	97	100	97
Delineators	N/A	91	100	76	88
Pavement Striping/Marking	68	86	97	97	89
Words and Symbols	97	100	100	93	98
Pavement Markers	55	64	95	86	78
Highway Lighting	97	96	96	67	89
Element Total	82.1	84.4	96.8	89.0	88.4

N/A - As discussed in the 2015 Q1 MRP Report, delineators were omitted from previous assessments and were added back in during the first quarter.

Maintenance Rating Program for the Triangle Expressway

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TABLE 6: MRP ROLLING ELEMENT RESULTS					
ELEMENT	Q4 2014 RATING	Q1 2015 RATING	Q2 2015 RATING	Q3 2015 RATING	ROLLING RATING
Road Surface	93	99	98	99	98
Unpaved Shoulders	95	100	97	100	98
Drainage	83	93	93	94	91
Roadside	83	88	87	86	86
Traffic Control Devices	82	84	97	89	88
Overall MRP Performance Rating	86.8	92.0	94.7	93.1	92.0

8.0 GREEN LEVEL HISTORIC DISTRICT SIGNS

The four Green Level Historic District signs and surrounding landscaped areas were installed as part of the Triangle Expressway construction projects. Currently, NCDOT is maintaining the Green Level Historic District Signs and the Town of Cary is providing maintenance to the landscaped areas surrounding these signs.

8.1 Analysis and Recommendations

As part of each quarterly inspection, assessors visit the four Green Level Historic District signs to conduct a visual inspection of each sign to ensure they are in good standing. During this quarterly inspection, all signs were found to be in good condition, with the landscaped areas being well maintained. **Figure 6** shows two of these signs.

Figure 6: Green Level West Historic District Signs



9.0 CONCLUSION

This report presents the 2015 third quarter and the current cumulative rolling annual assessment of the Triangle Expressway. The NCTA's target ratings are 90 overall, 85 for elements and 80 for characteristics. The third quarter 2015 overall rating is 93.1 and the cumulative rolling rating is 92.0. The quarterly and cumulative rolling ratings for this quarter are currently above the target rating of 90.

This quarter all element ratings were above the target rating for both the quarterly and rolling annual scores. However, Traffic Control Devices experienced a decline in rating due to low scores for Pavement Markers, Delineators and Highway Lighting. All characteristics' quarterly ratings exceeded the target rating of 80 with the exception of Turf Condition (47), Retaining, Sound and Screen Walls (79), Delineators (76), and Highway Lighting (67). Also, based on the cumulative rolling assessment ratings, only Miscellaneous Drainage Structures (74), Turf Condition (49) and Pavement Markers (78) fell below the threshold.

In order to improve this quarter's ratings, it is recommended that the maintenance provider continue to plan to remove any ditch debris that may impair outflow from the shoulder drain outlets on a routine basis, and continue to check pavement markers after the seasons of inclement weather. It is also recommended that the maintenance provider repair sound barrier wall joints or pursue the warranty clause with the Design Build contractor as a warranty workmanship related issue. In addition, it is recommended that guardrail delineators be replaced and that mowing operators be trained to avoid damaging the delineators in the future.

Turf Condition is continuing to fail for both the quarterly and the cumulative rolling ratings, and needs the most attention. It is recommended that soil nourishment through a routine fertilizing campaign and selective hydro-seeding of bare ground areas with warm season grasses continue throughout the summer of 2016.

Additionally, routine attention and planning should be given to the nighttime visibility program. A continued replacement program for pavement markers should be scheduled routinely at or near a three-year cycle in order to maintain their nighttime effectiveness and reflectivity. While the rating for Pavement Striping exceeded the target rating for both the 2015 third quarter and the rolling rating, the lifespan of epoxy paint and pavement markers is 3 to 5 years. Pavement striping was installed along sections of the Triangle Expressway over 3 years ago and therefore, preparations should be made in the budget and work schedule for maintenance.

All Green Level Historic District signs inspected during the third quarter were found to be in good condition. Also, the landscaped areas surrounding the signs are being well maintained; preserving sign visibility and aesthetic appearance.

Appendix A

Triangle Expressway 2015 Third Quarter Asset Assessment Locations

Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

Provided below are a series of maps outlining the assets that were a part of this quarter's sample and their corresponding result. Assets are defined by an Inventory ID, which is a unique identifier given to each individual asset. The components that make up the Inventory ID are an asset specific prefix along with a number, such as LS_1. All assets and their respective prefixes are listed below:

- Guardrail, Concrete Barrier and End Anchors – BR
- Curb and Gutter – CG
- Decorative Supports – DS
- Drainage Pipes – DP
- Misc. Drainage Structures – MDP
- Fence and Control of Access – FN
- Graffiti - GF
- Highway Lighting – HL
- Impact Attenuators – IA
- Inlets – IN
- Landscaping – PB
- Linear Samples – LS
 - Paved Lanes – Asphalt
 - Paved Lanes – Concrete
 - Paved Shoulders
 - Unpaved Shoulders
 - Front/Back Slopes
 - Unpaved Lateral and Outfall Ditches
 - Litter
 - Roadway Sweeping
 - Pavement Striping/Markings
 - Pavement Markers
 - Delineators
- Paved Ditches – PD
- Pavement Words and Symbols – PS
- Signs – SN
- Tree and Brush – TB
- Turf Condition – TF
- MSE/Retaining Walls, Sound Barrier Walls, and Screen Walls – WL

Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations



Legend

- Passing Asset
- Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

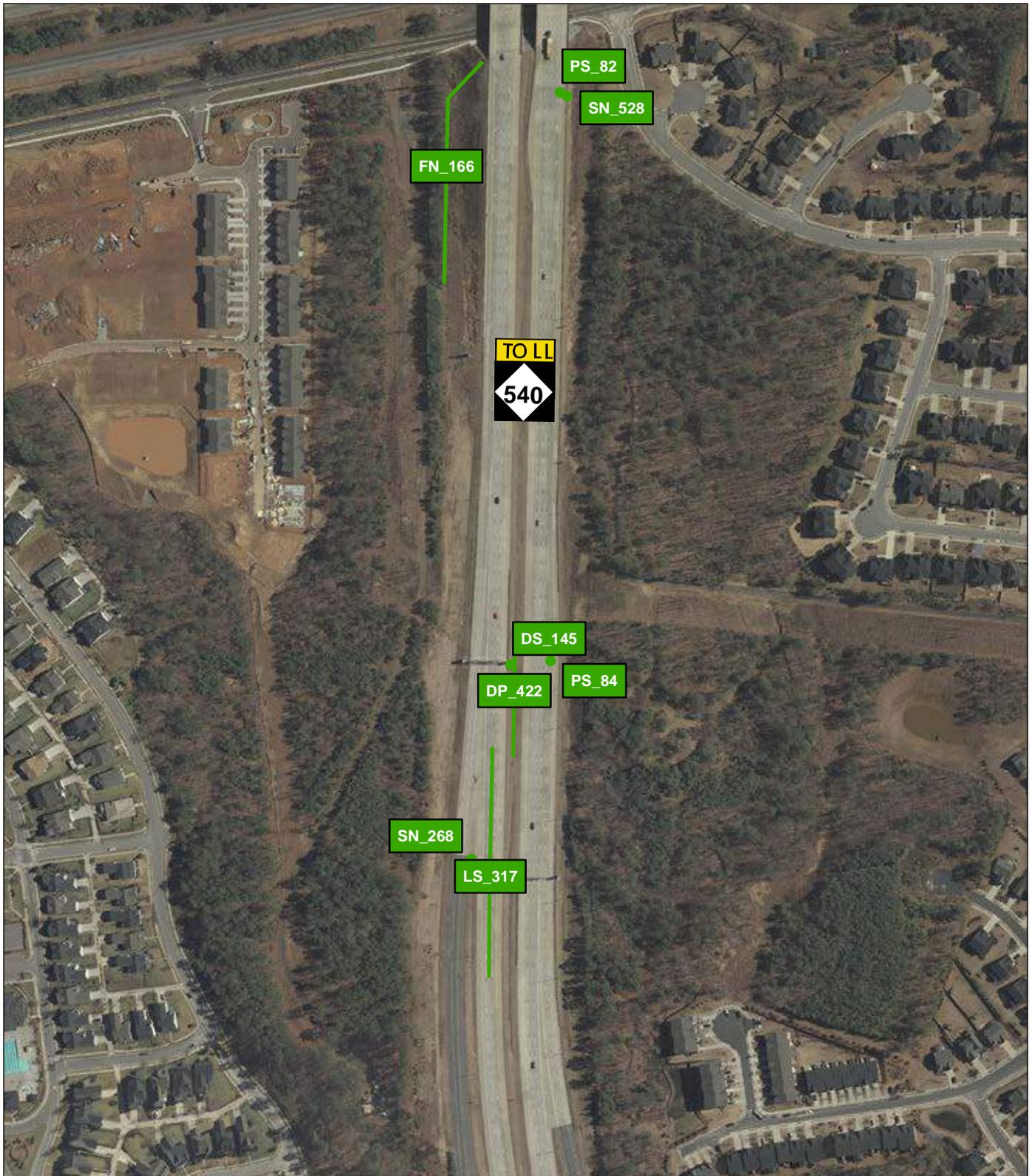


Legend

-  Passing Asset
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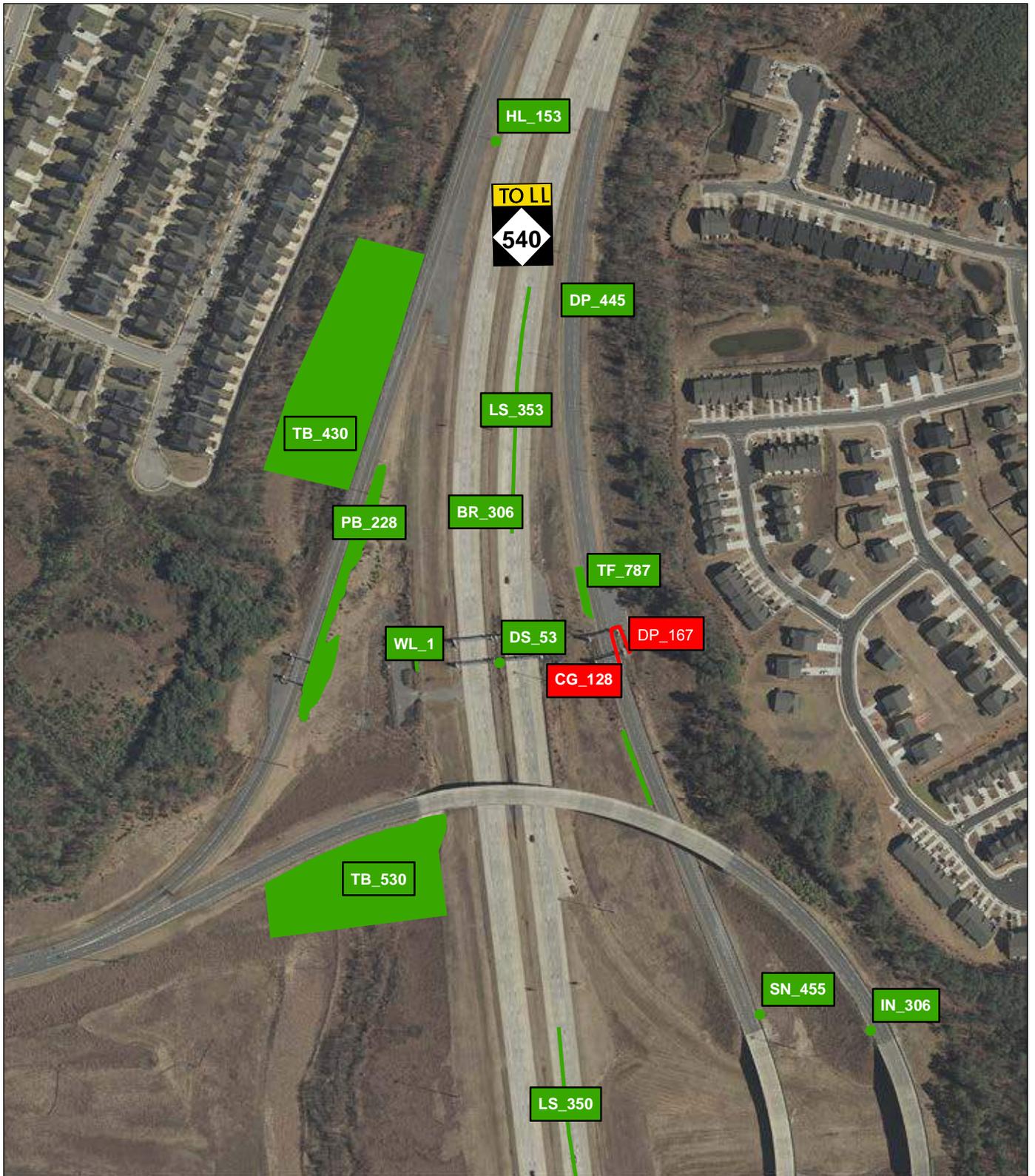


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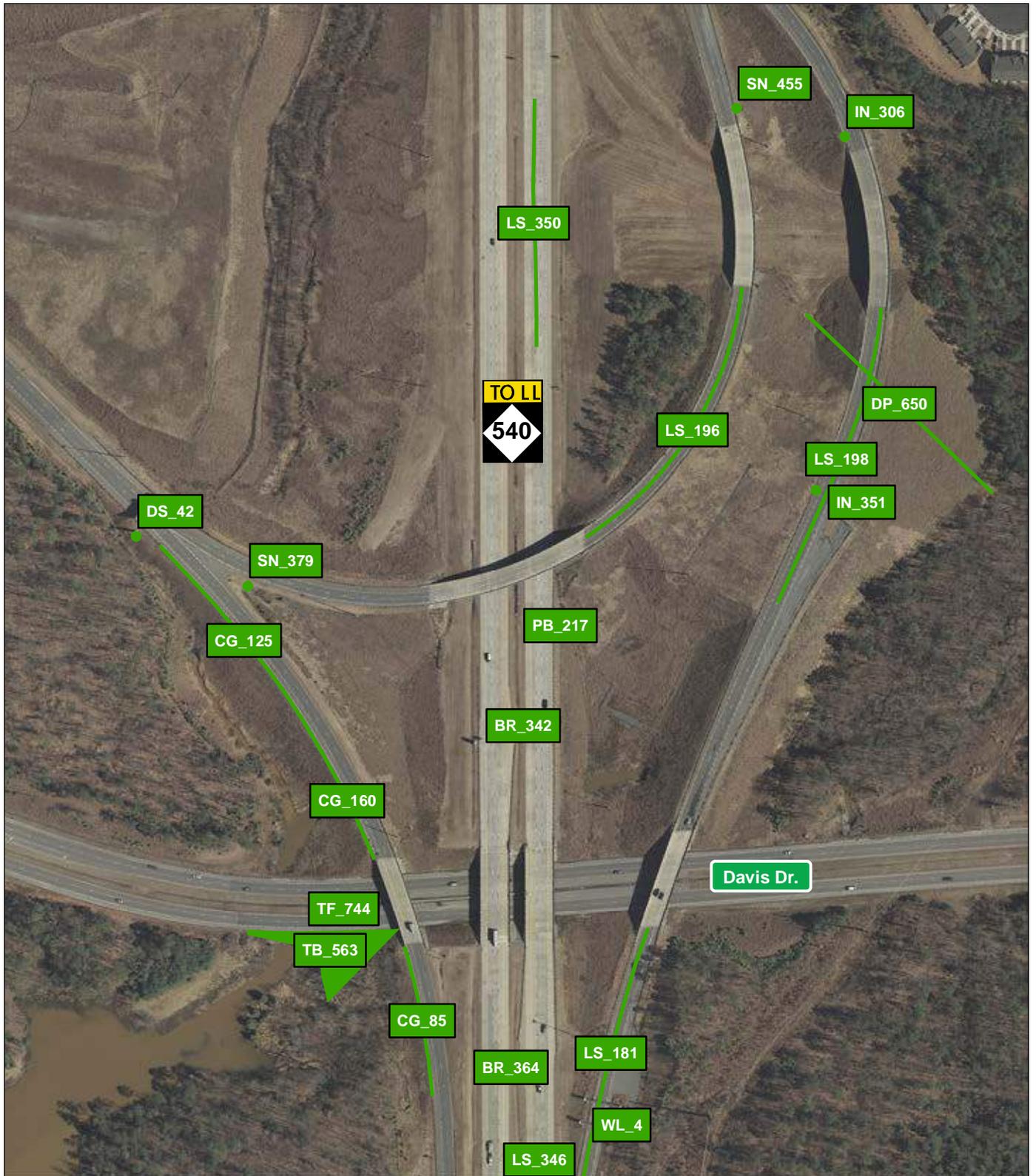


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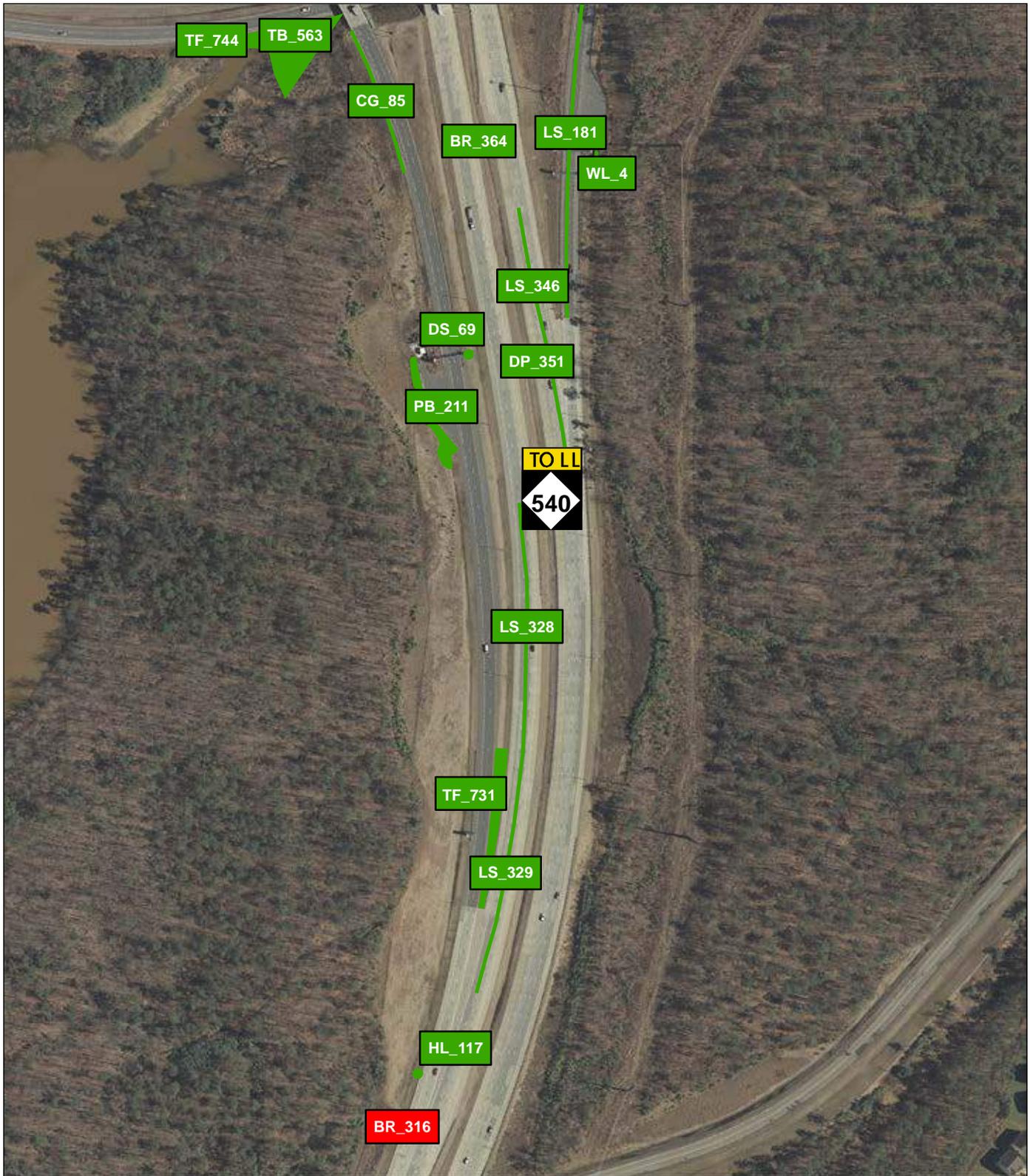


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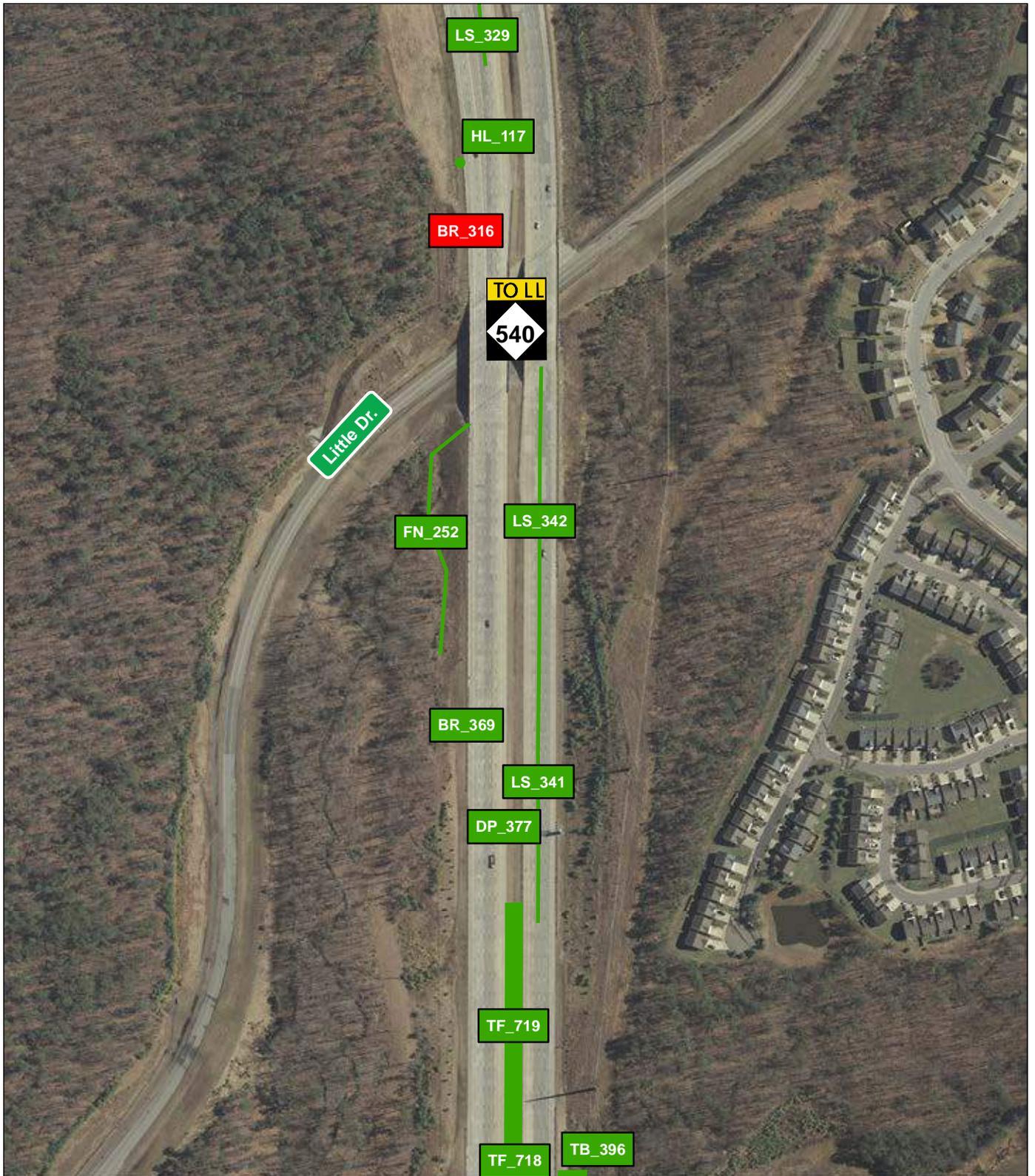


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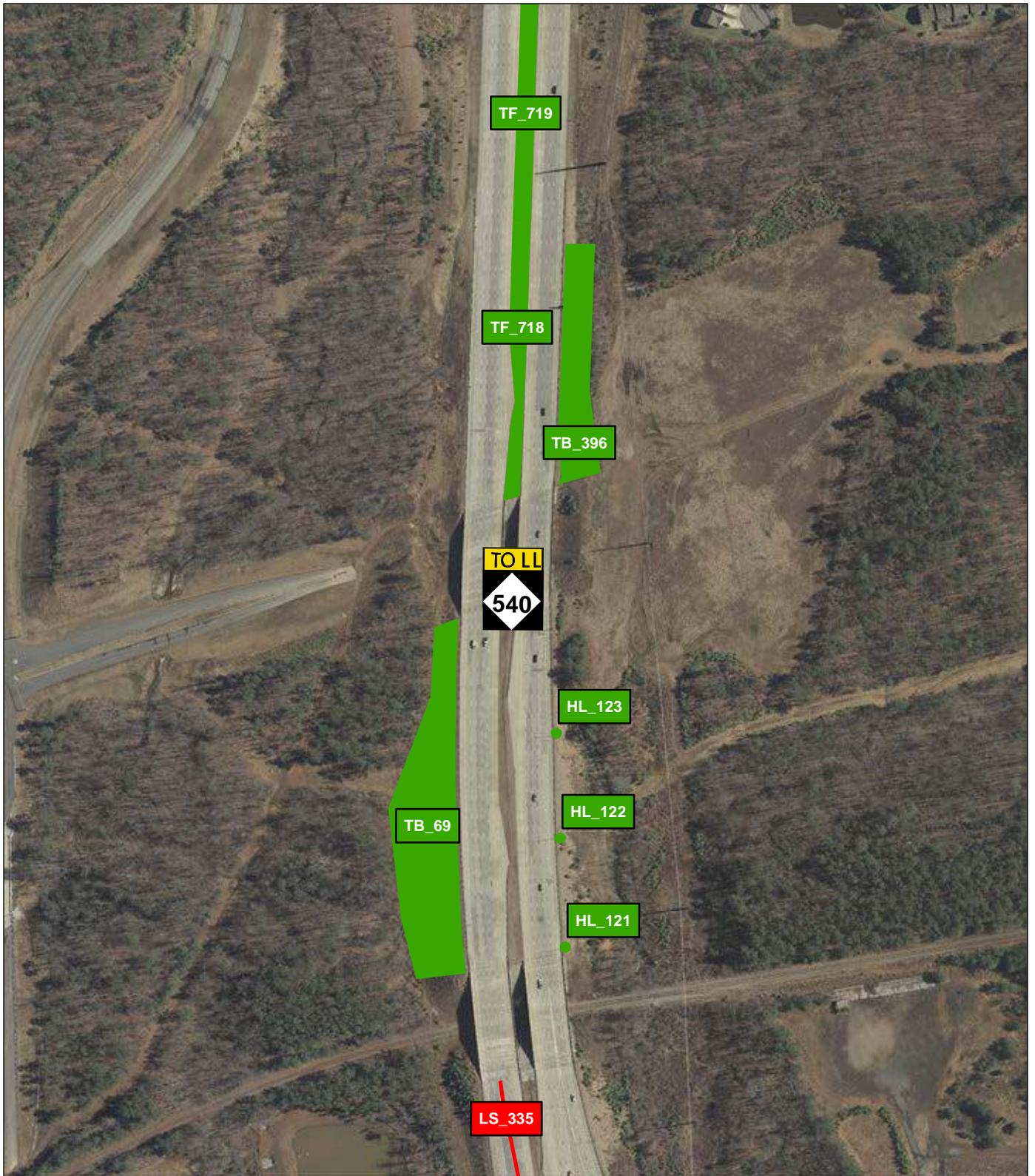


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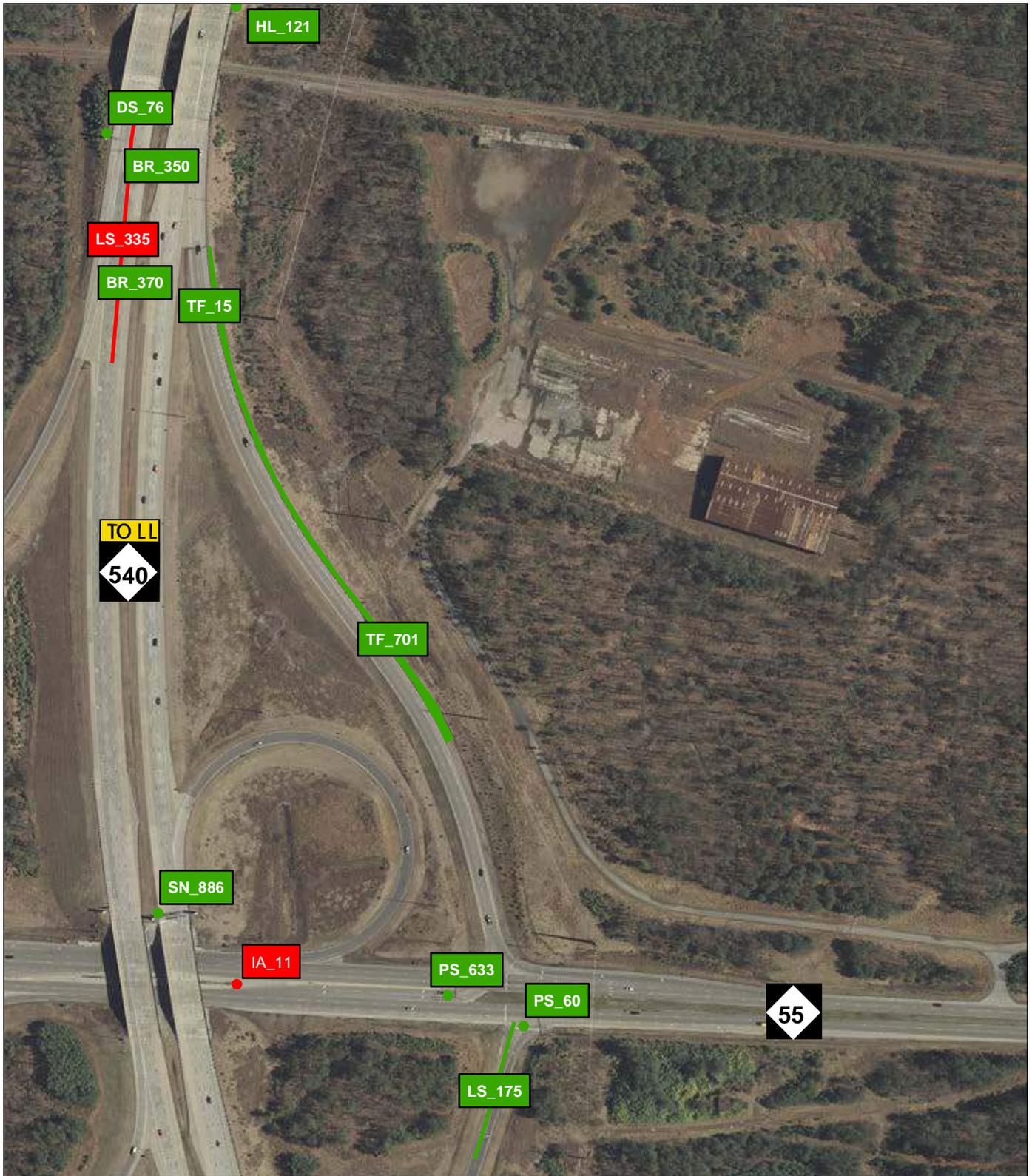


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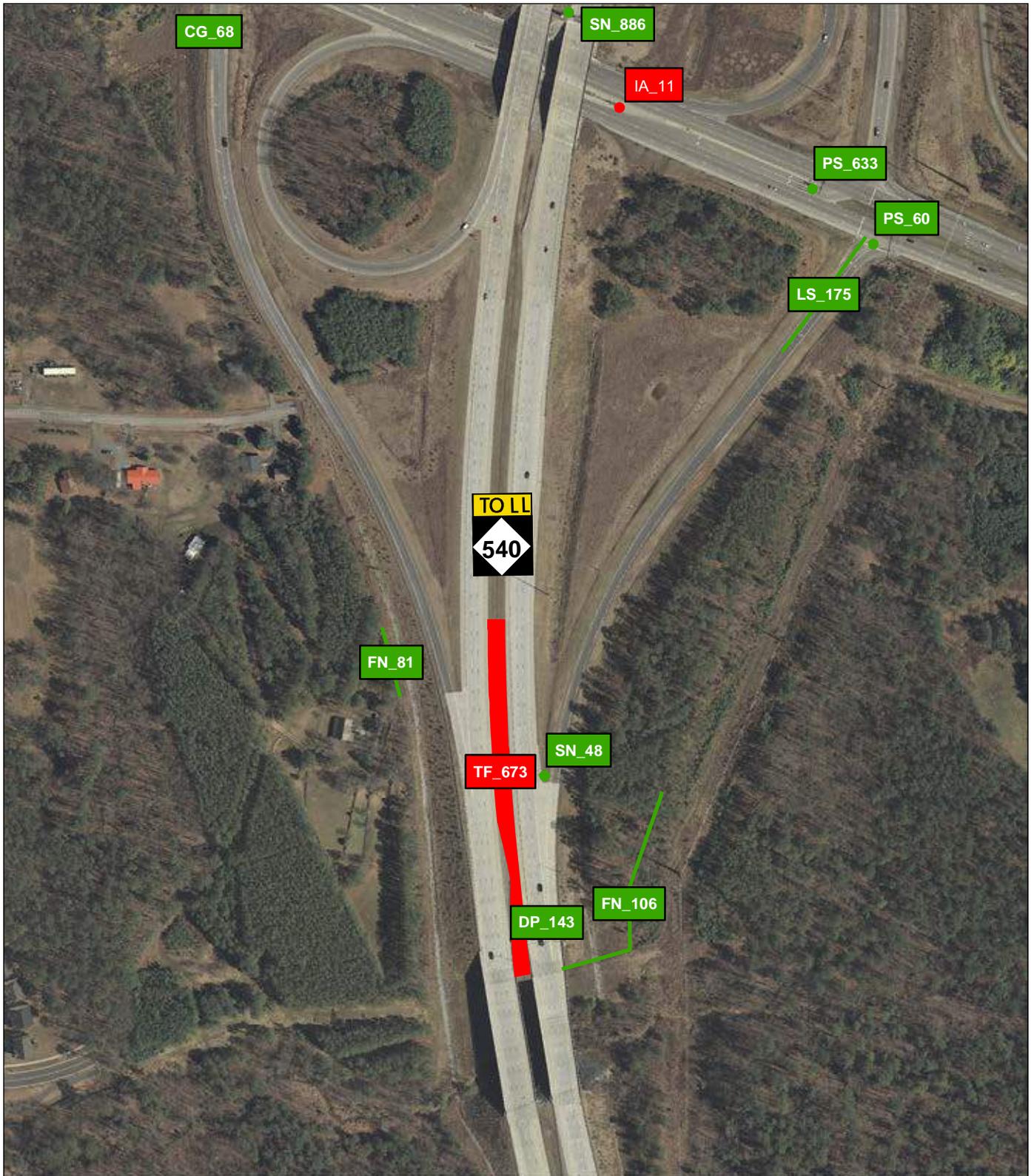


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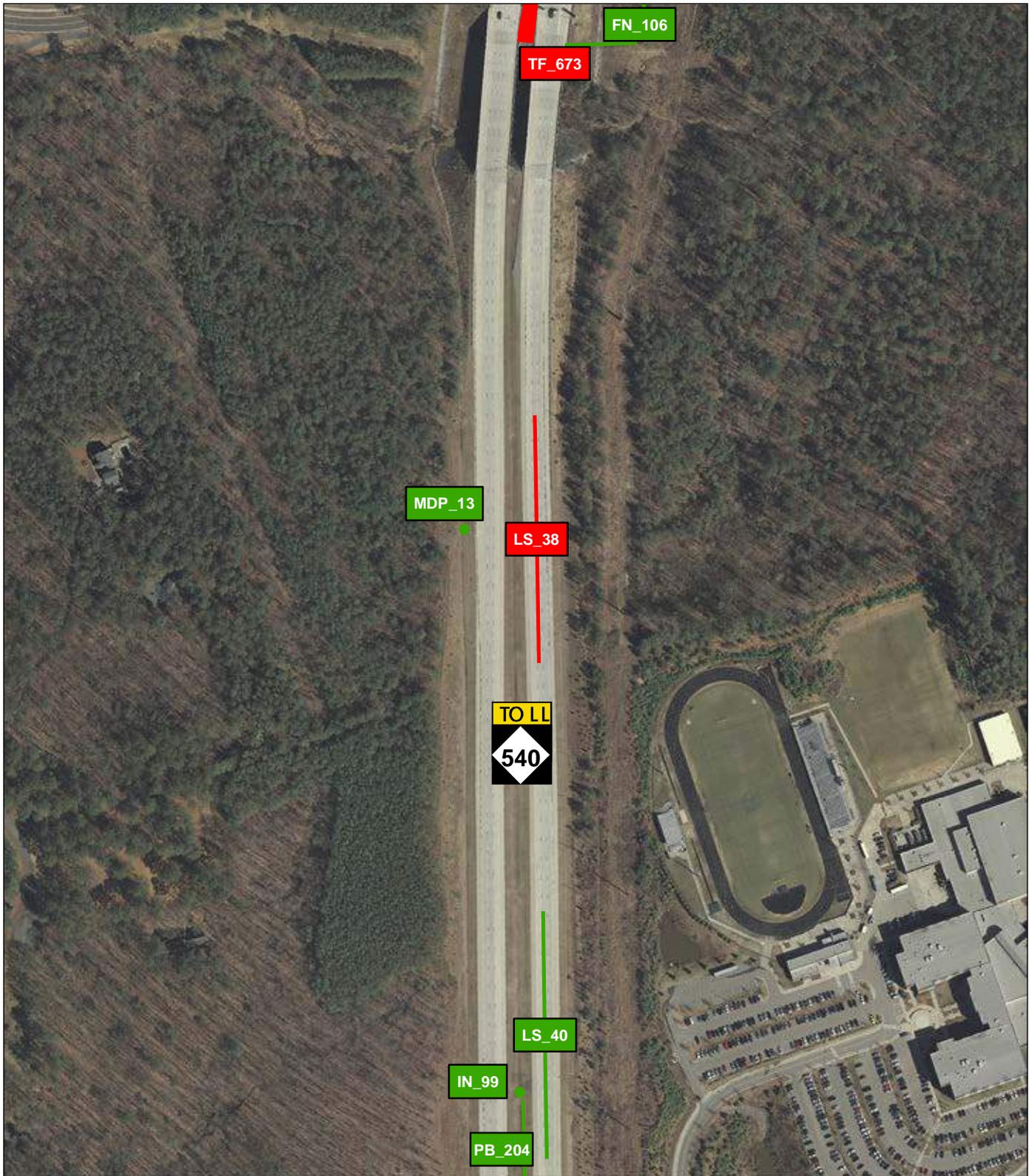


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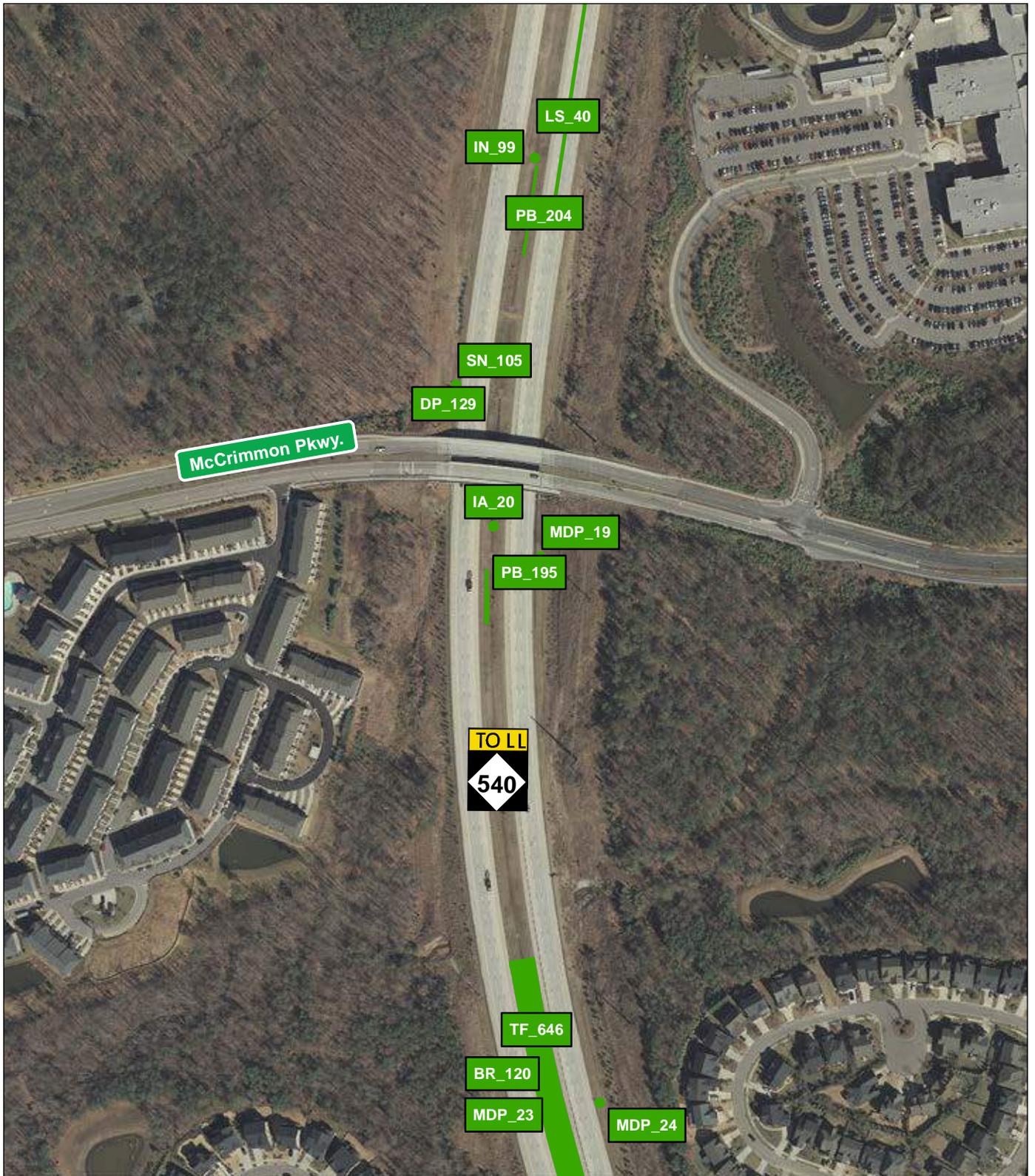


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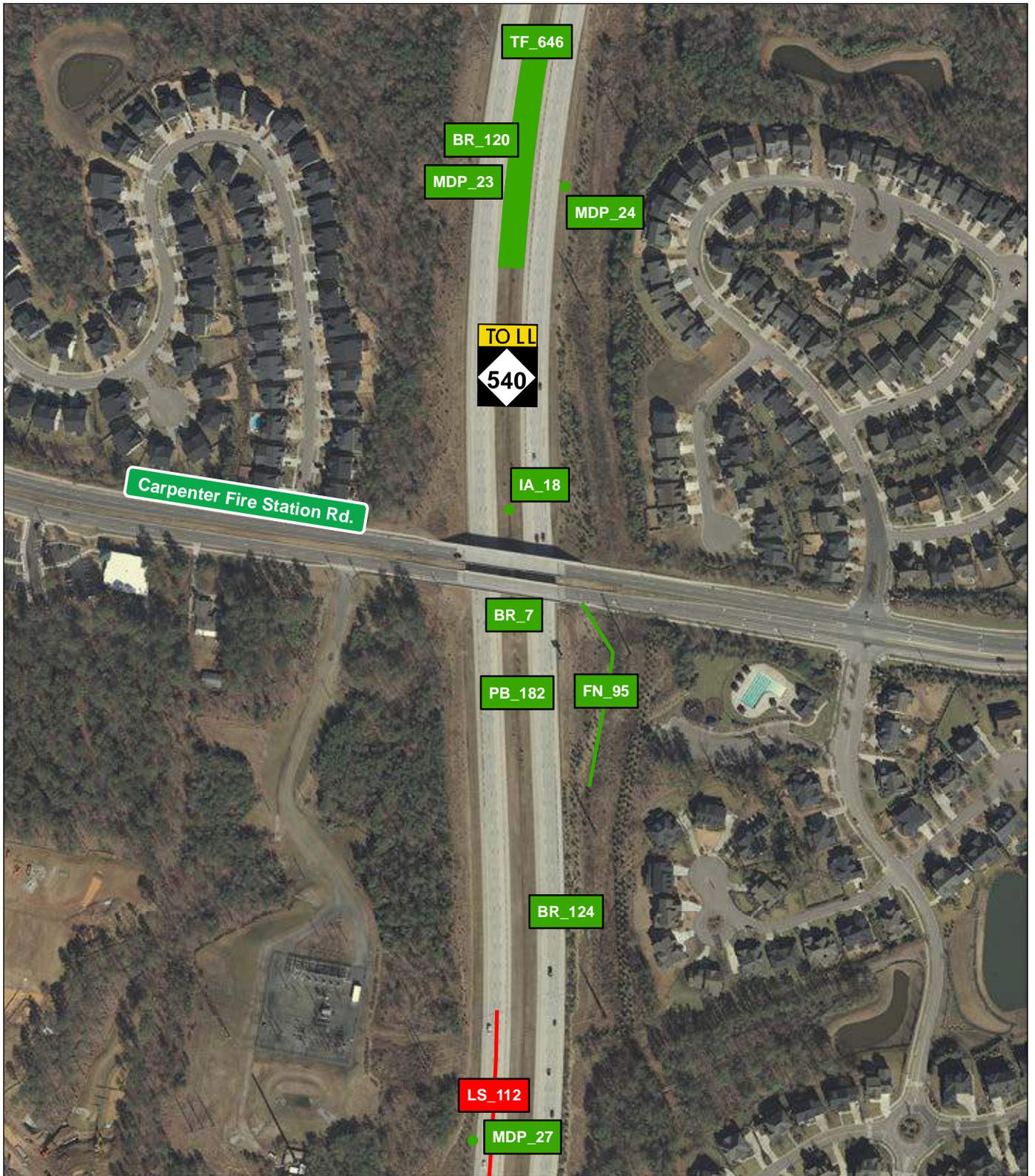


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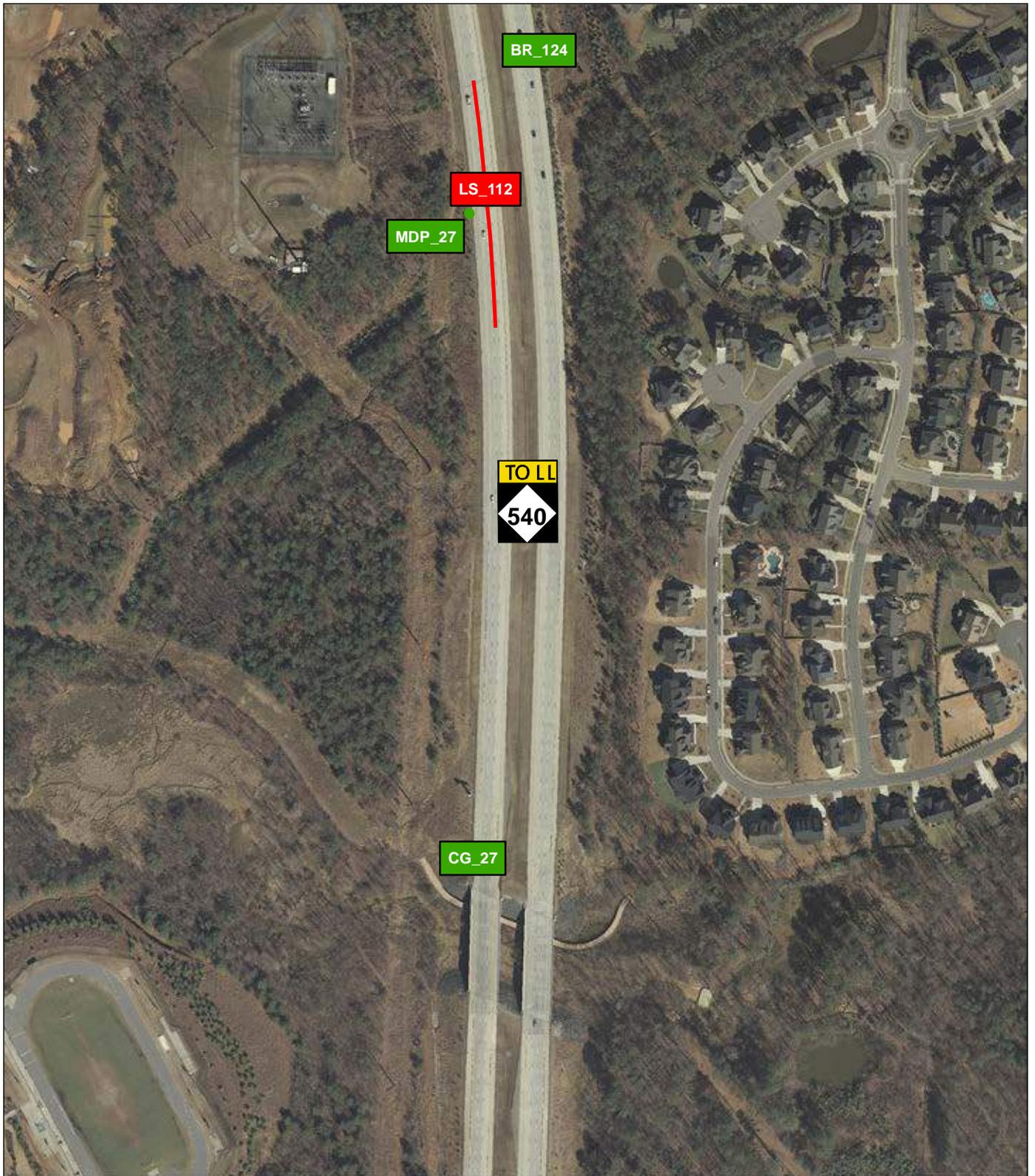


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

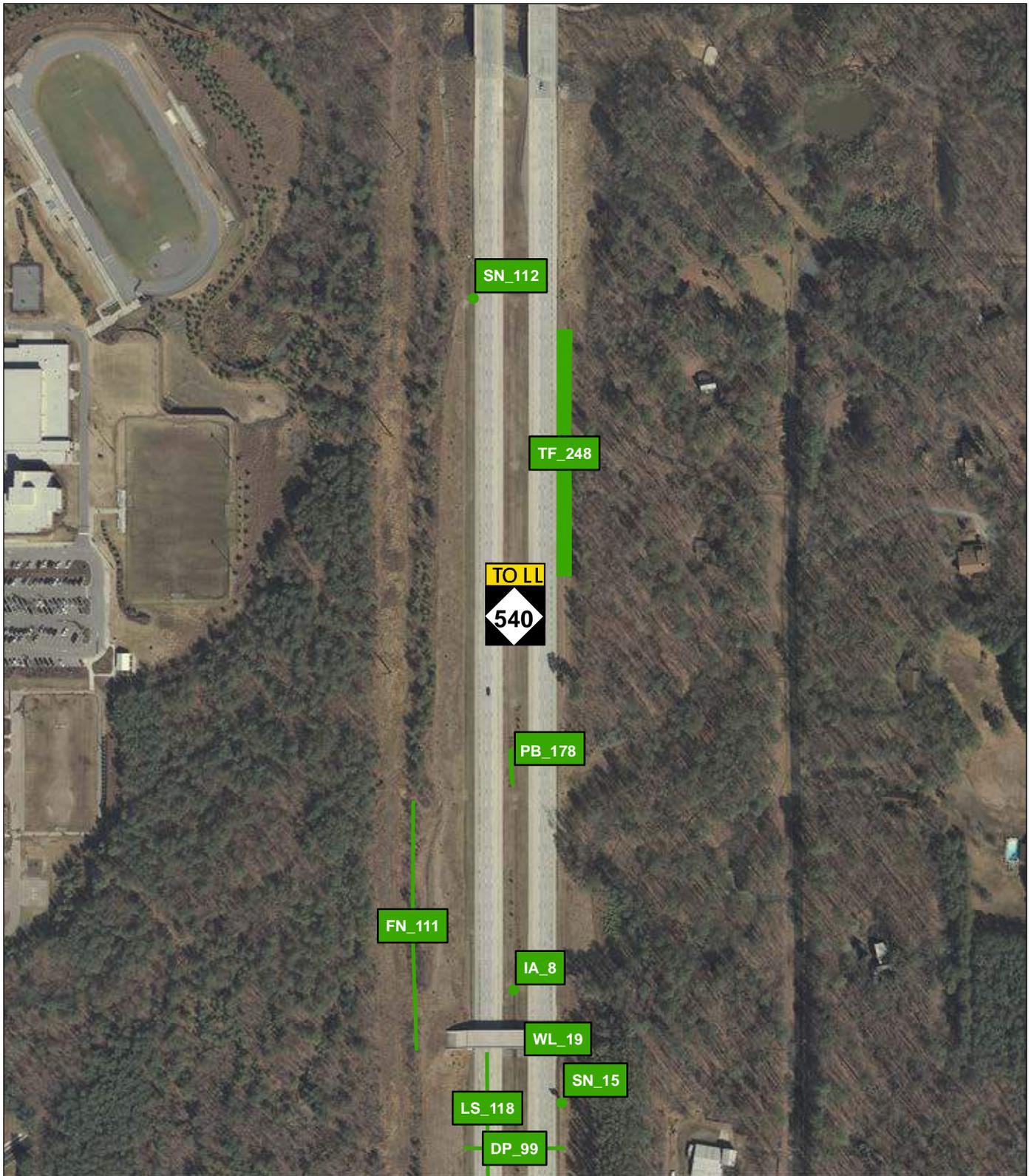


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

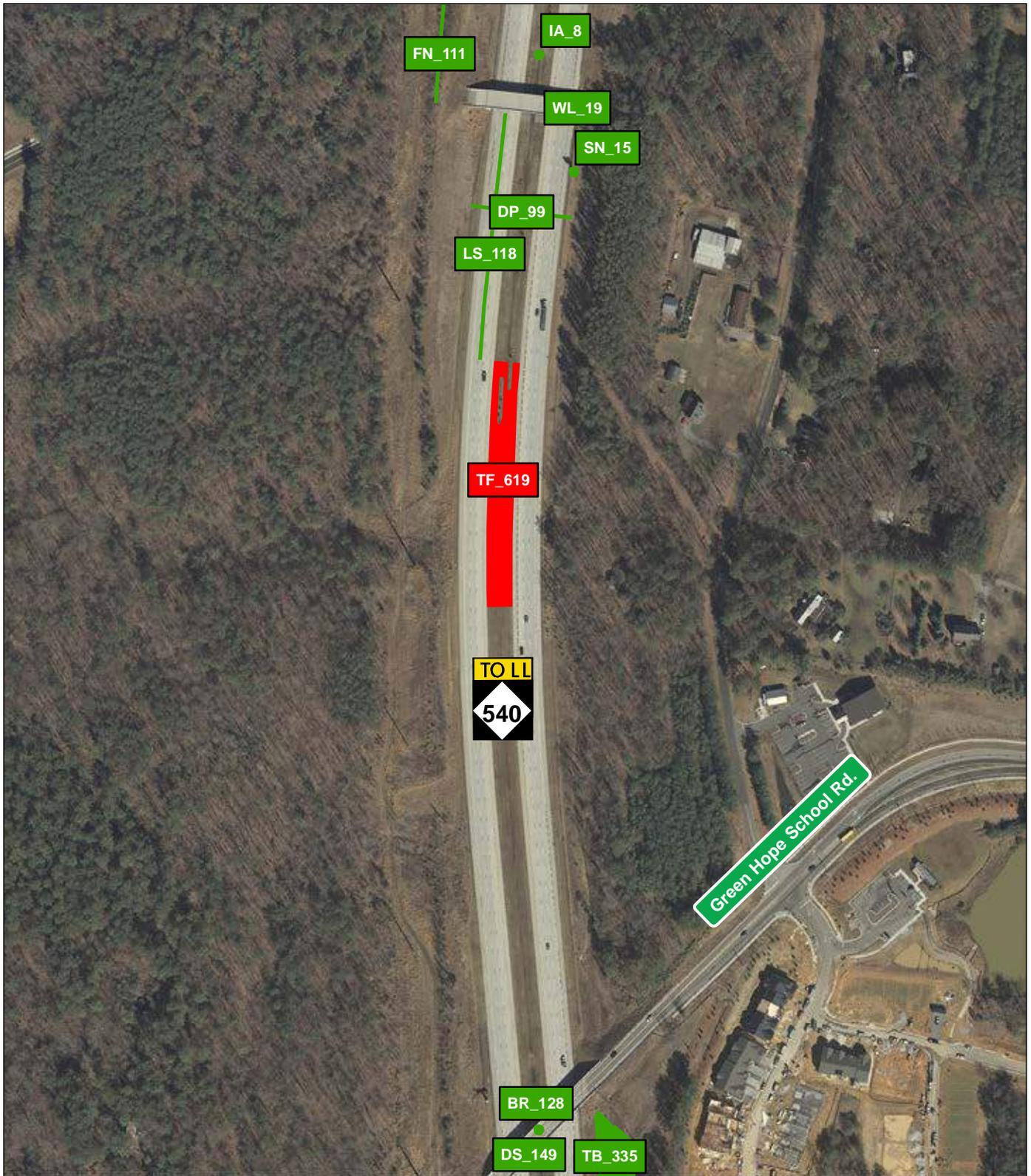


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

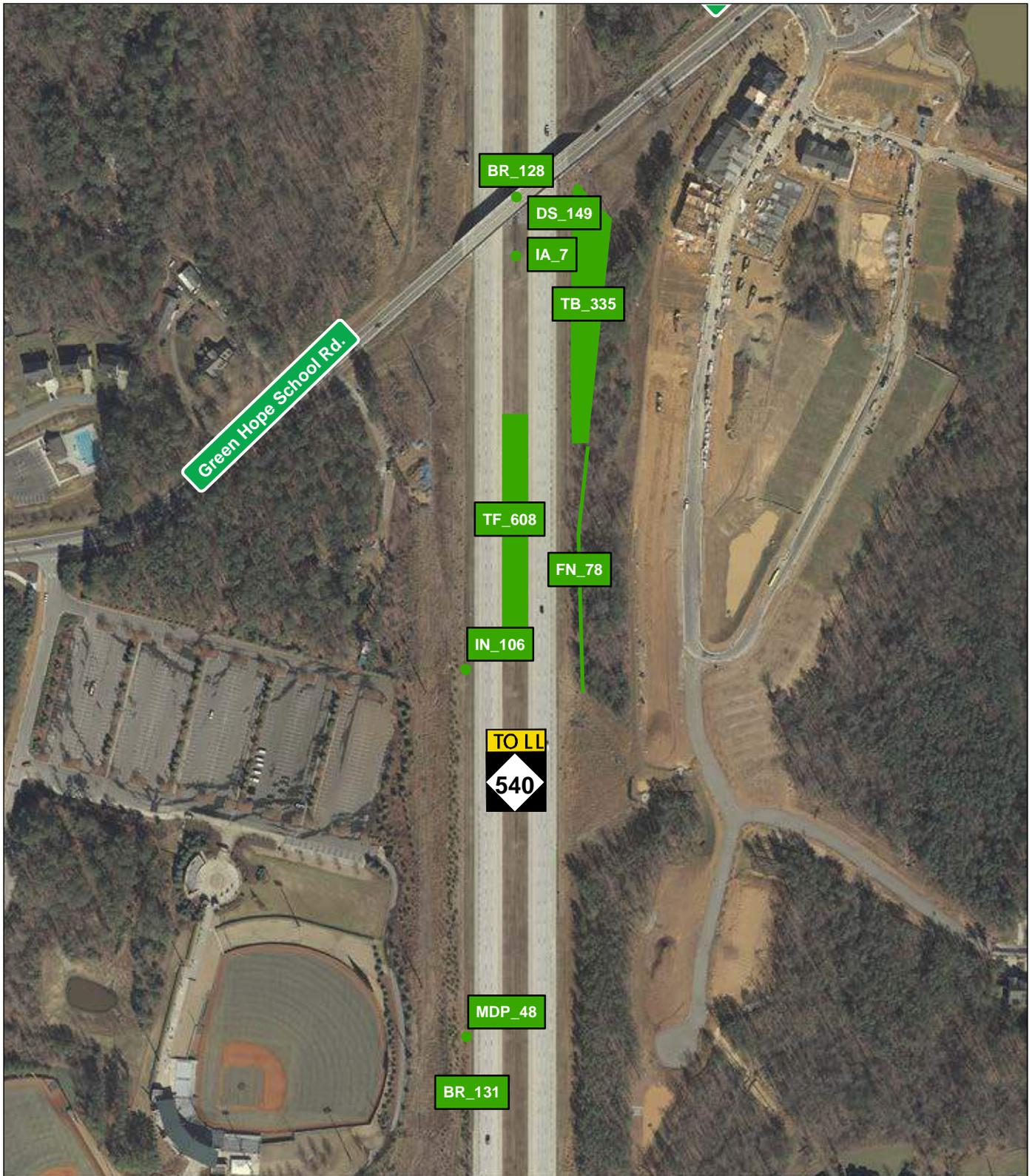


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

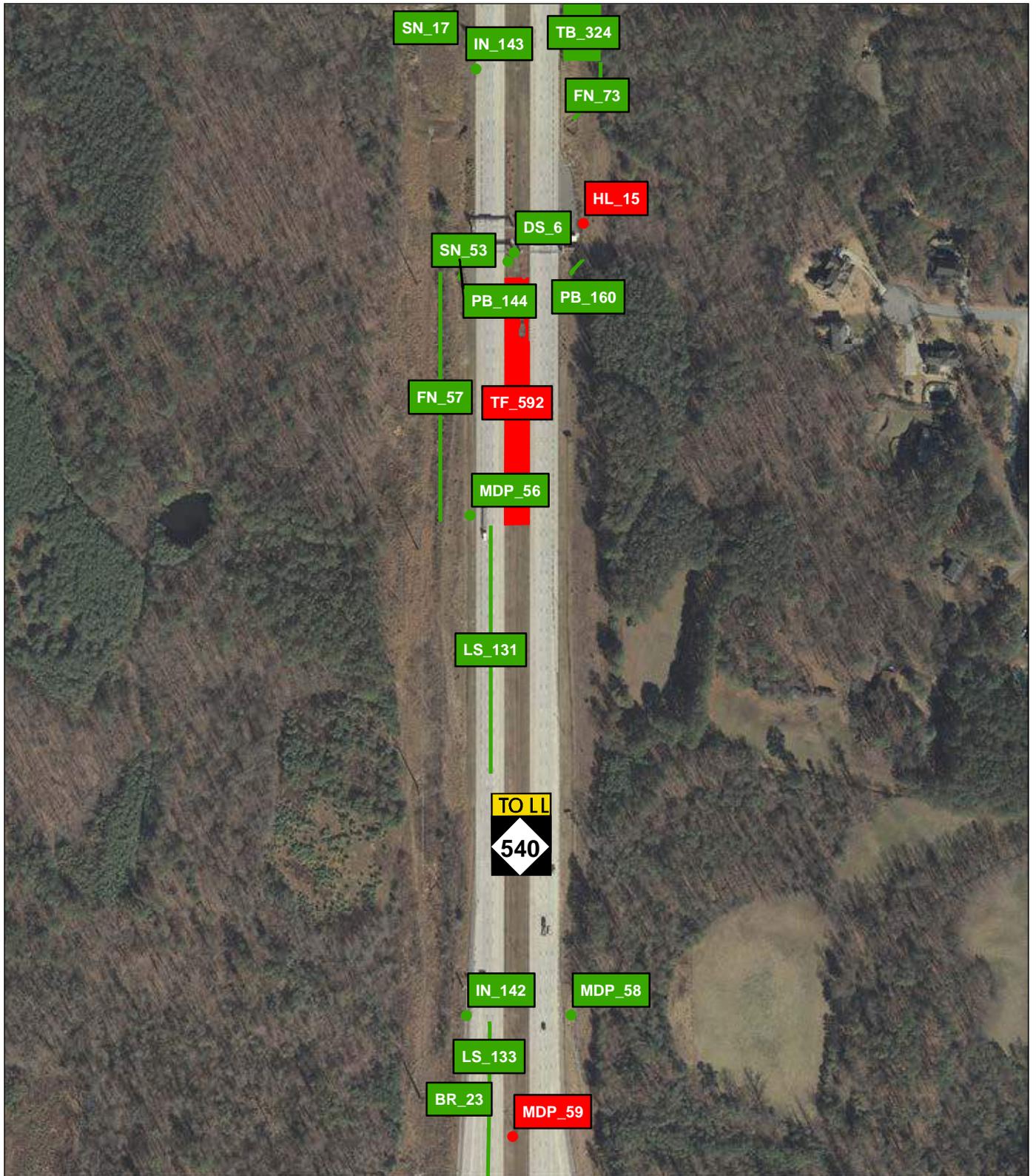


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

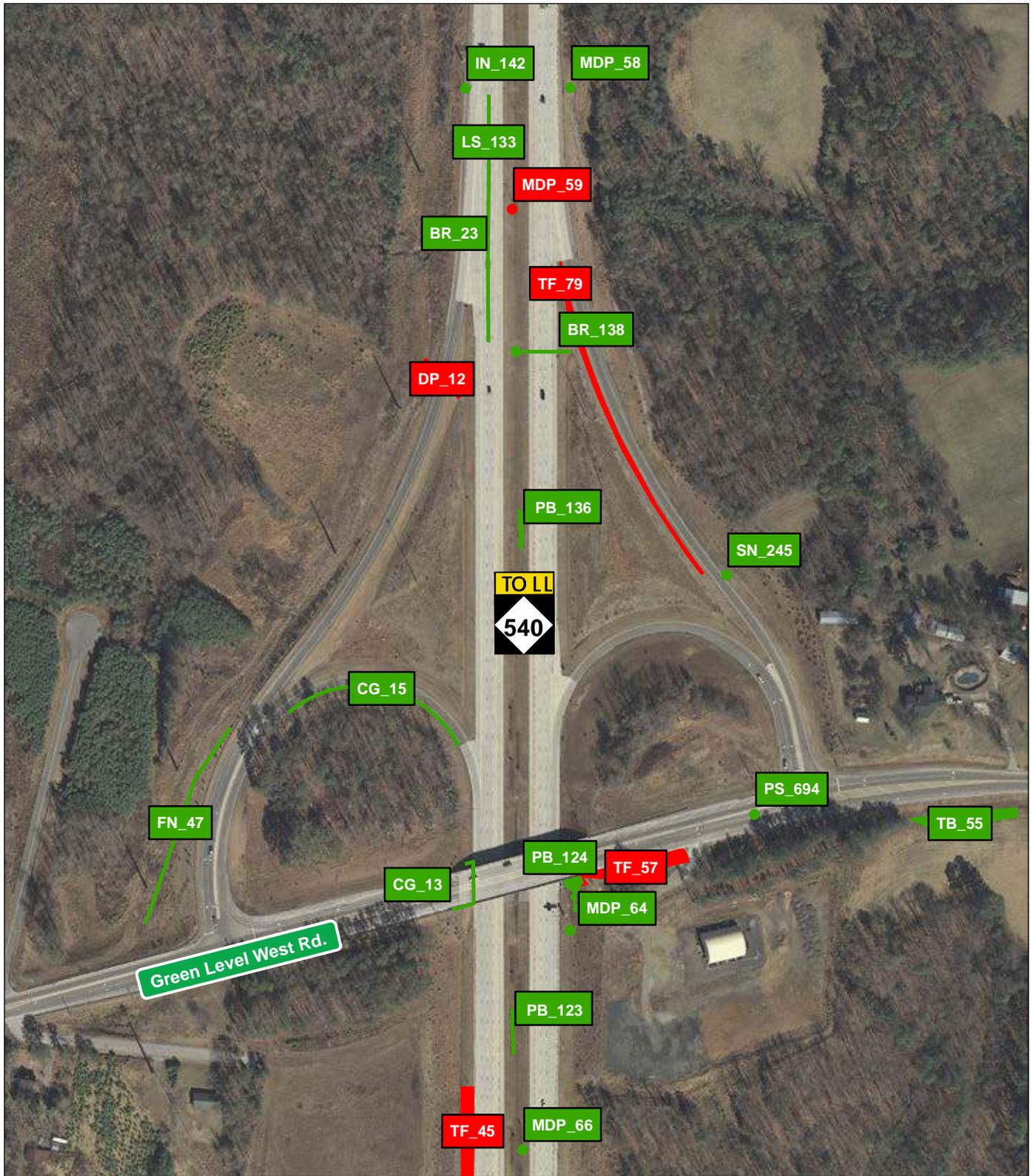


Legend

- Passing Asset
- Failing Asset

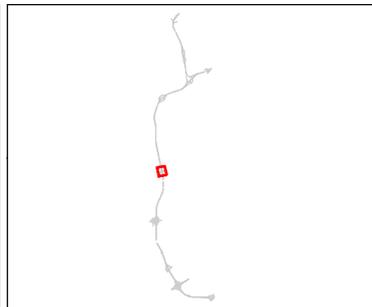


Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

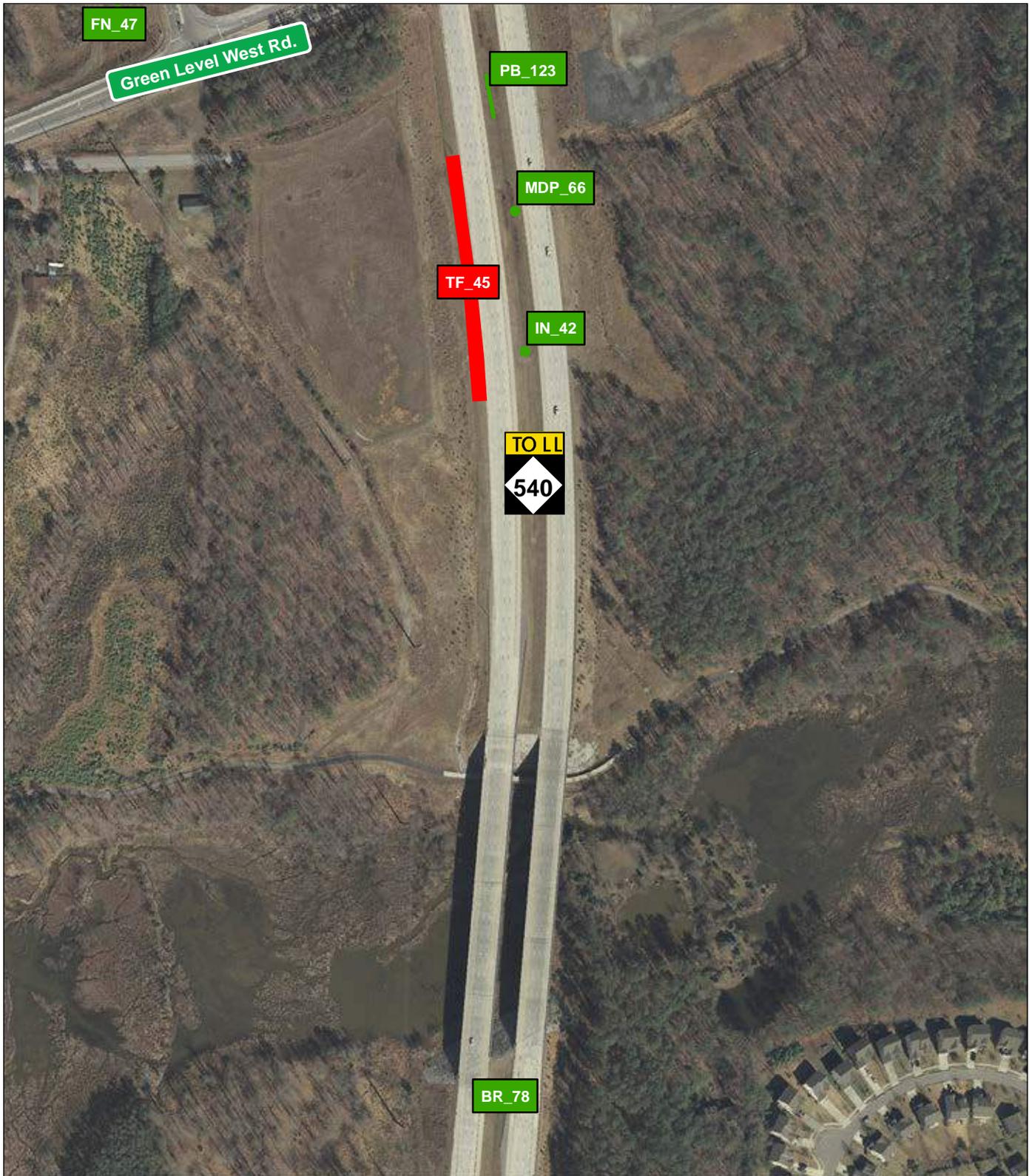


Legend

- Passing Asset
- Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

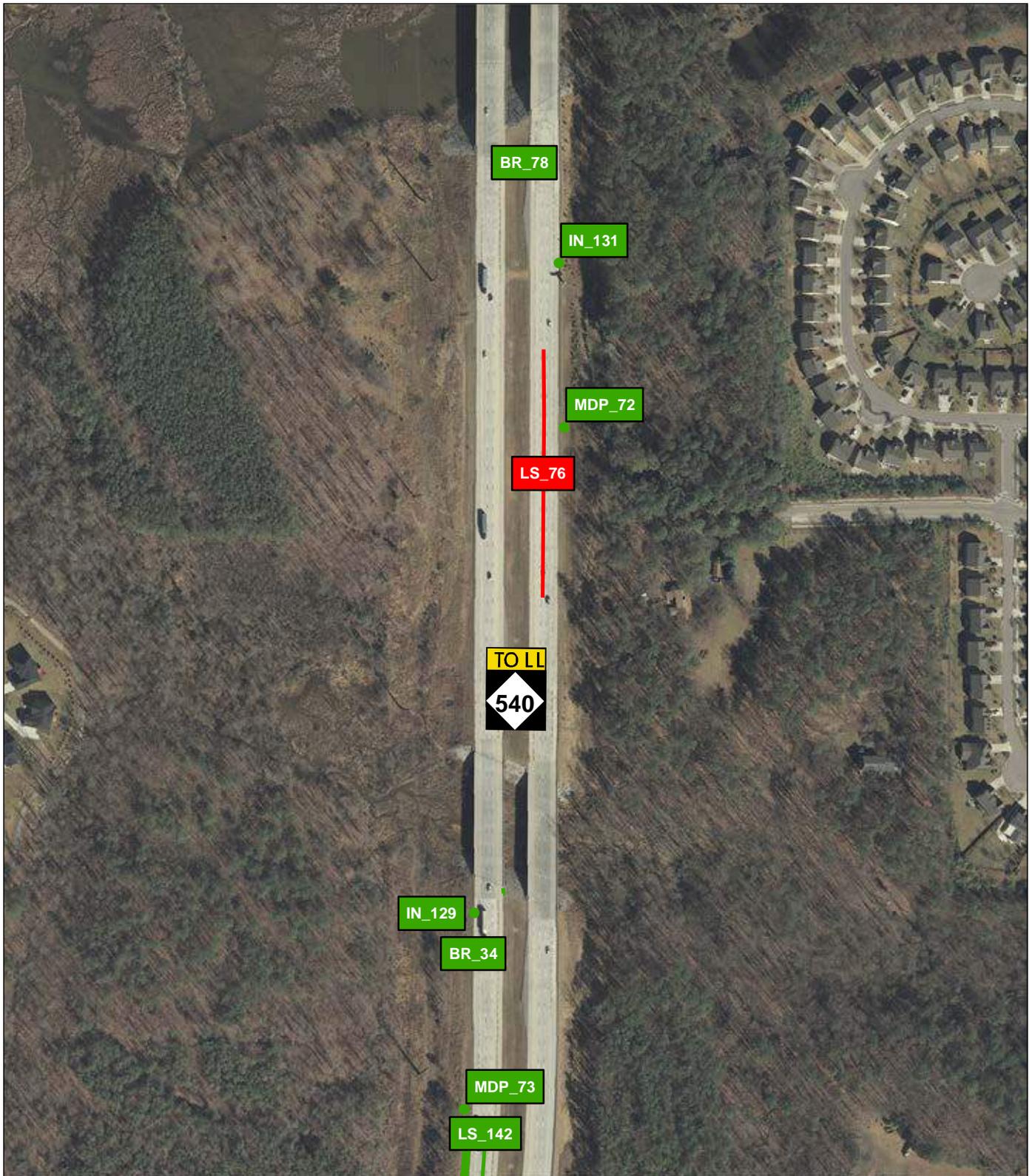


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

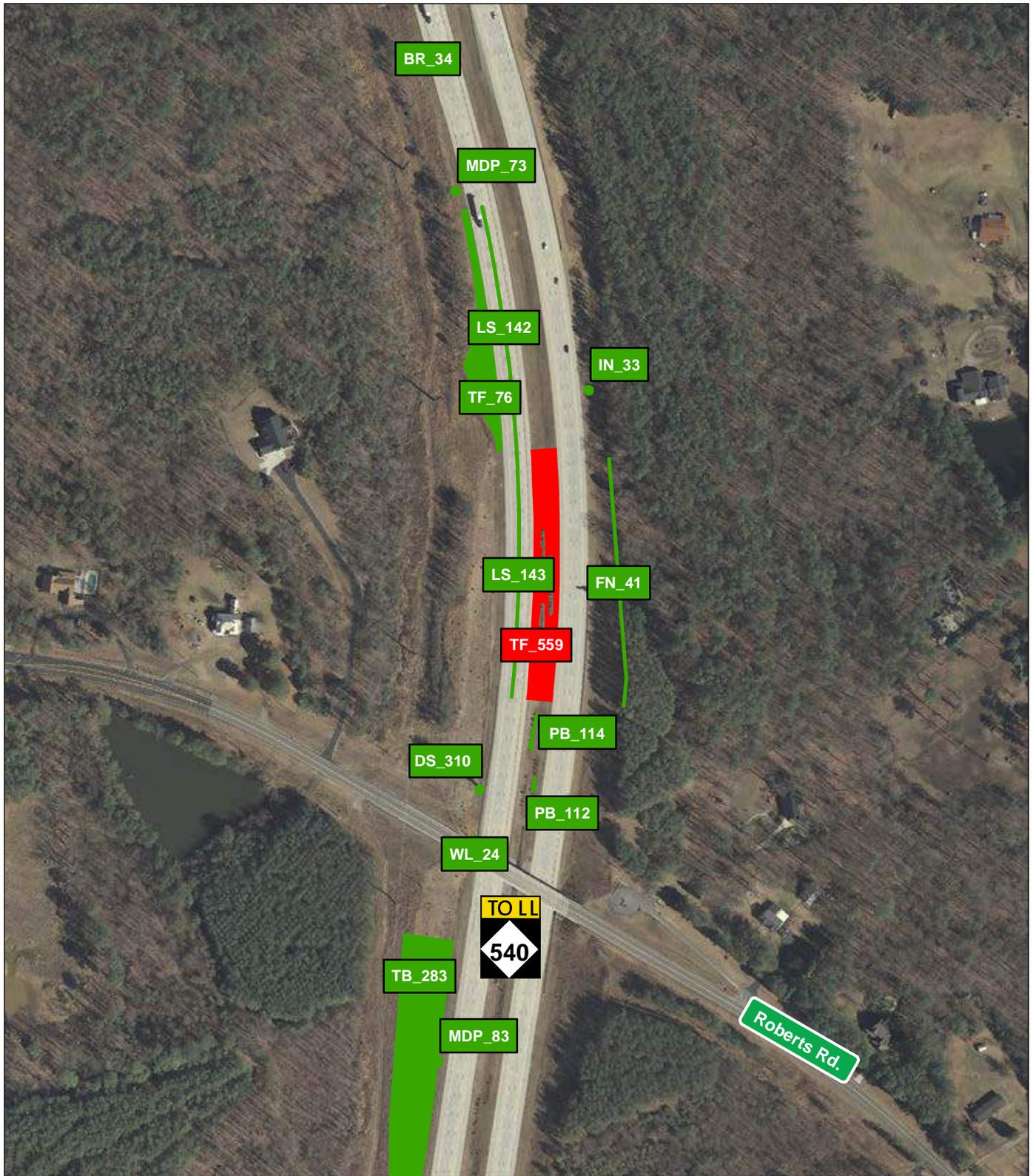


Legend

-  Passing Asset
-  Failing Asset

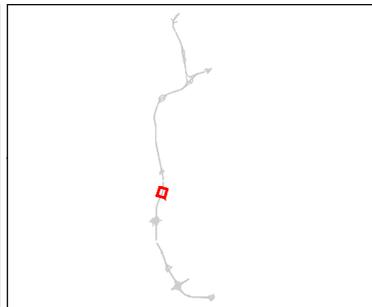


Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

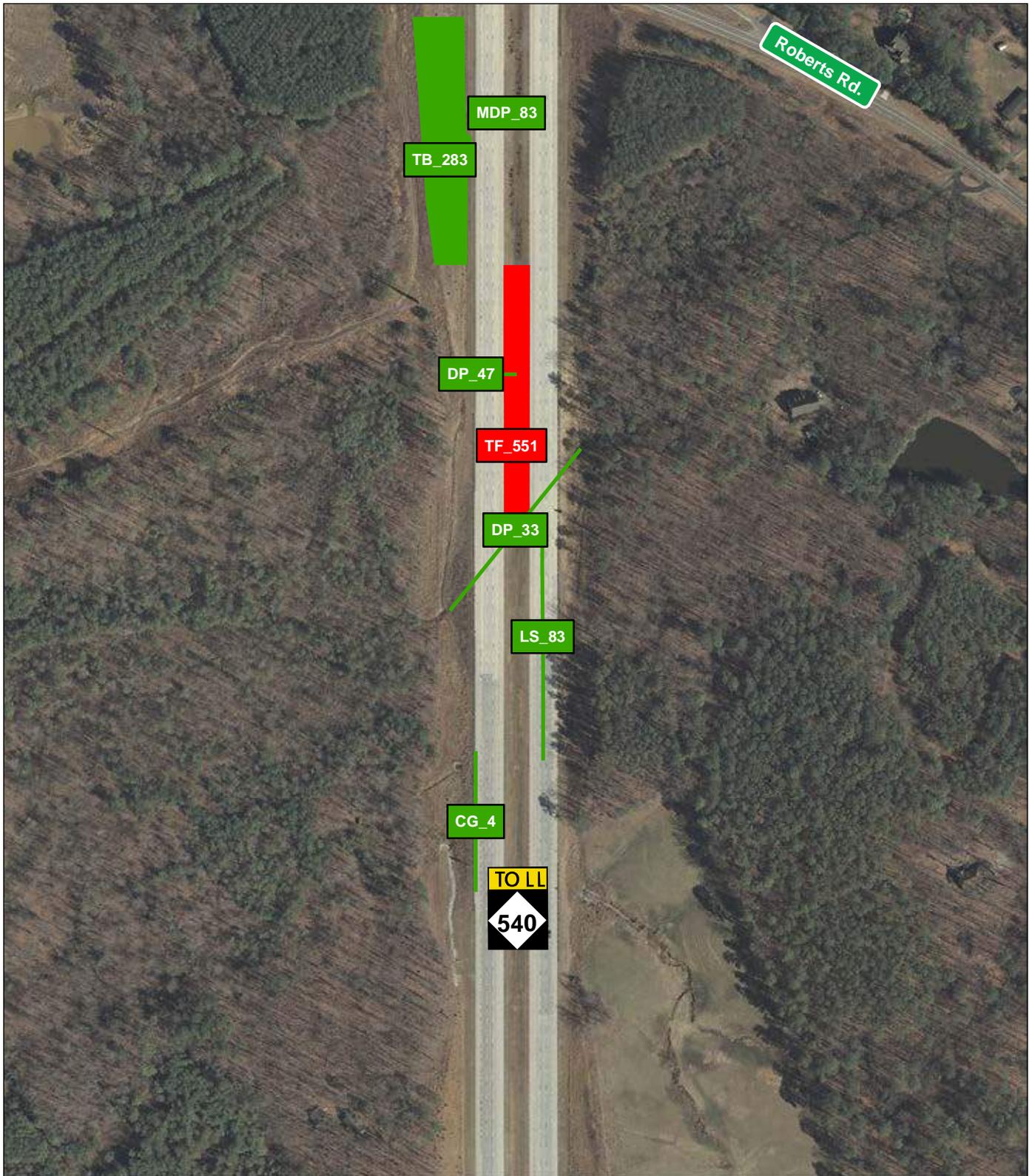


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

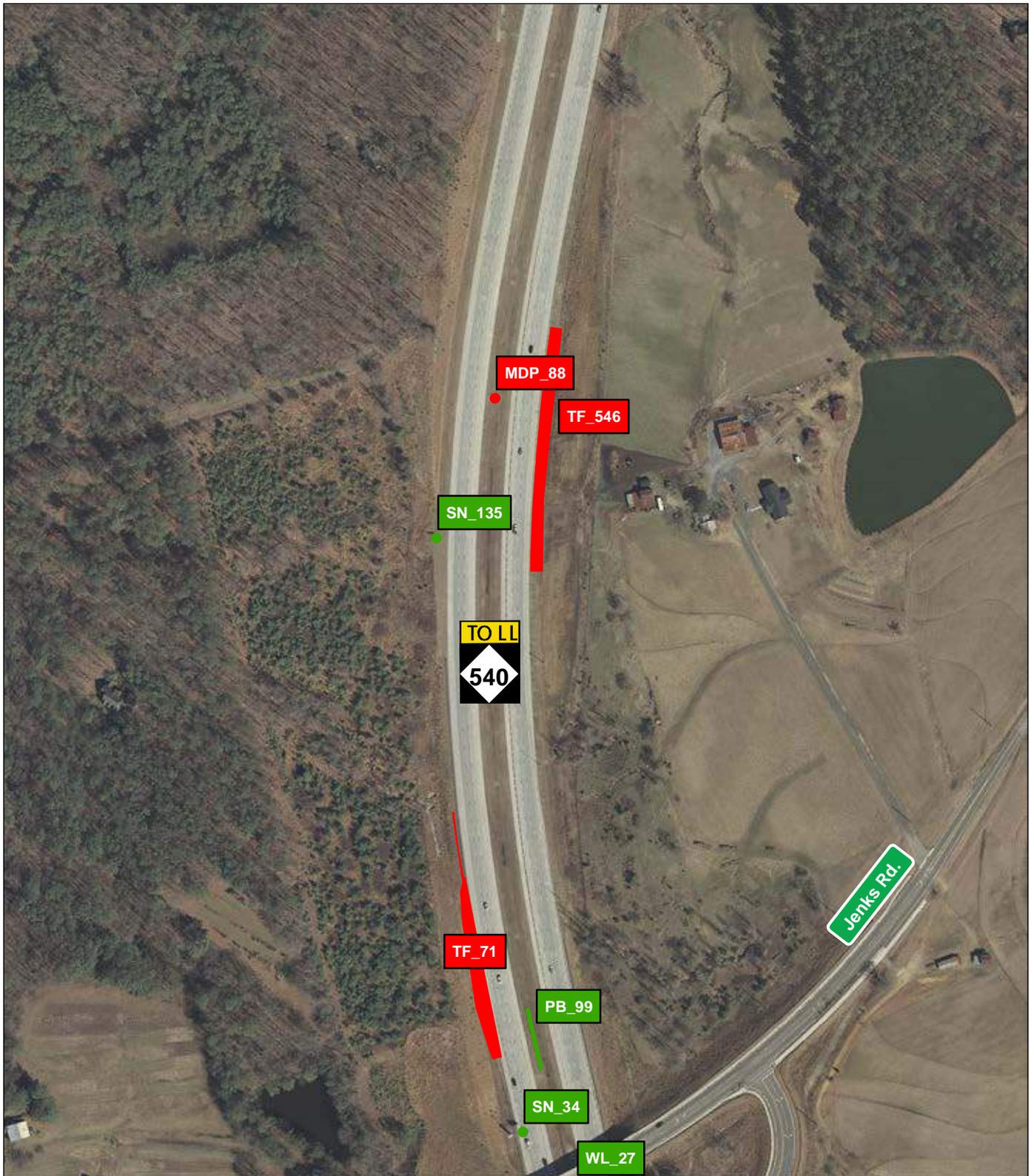


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

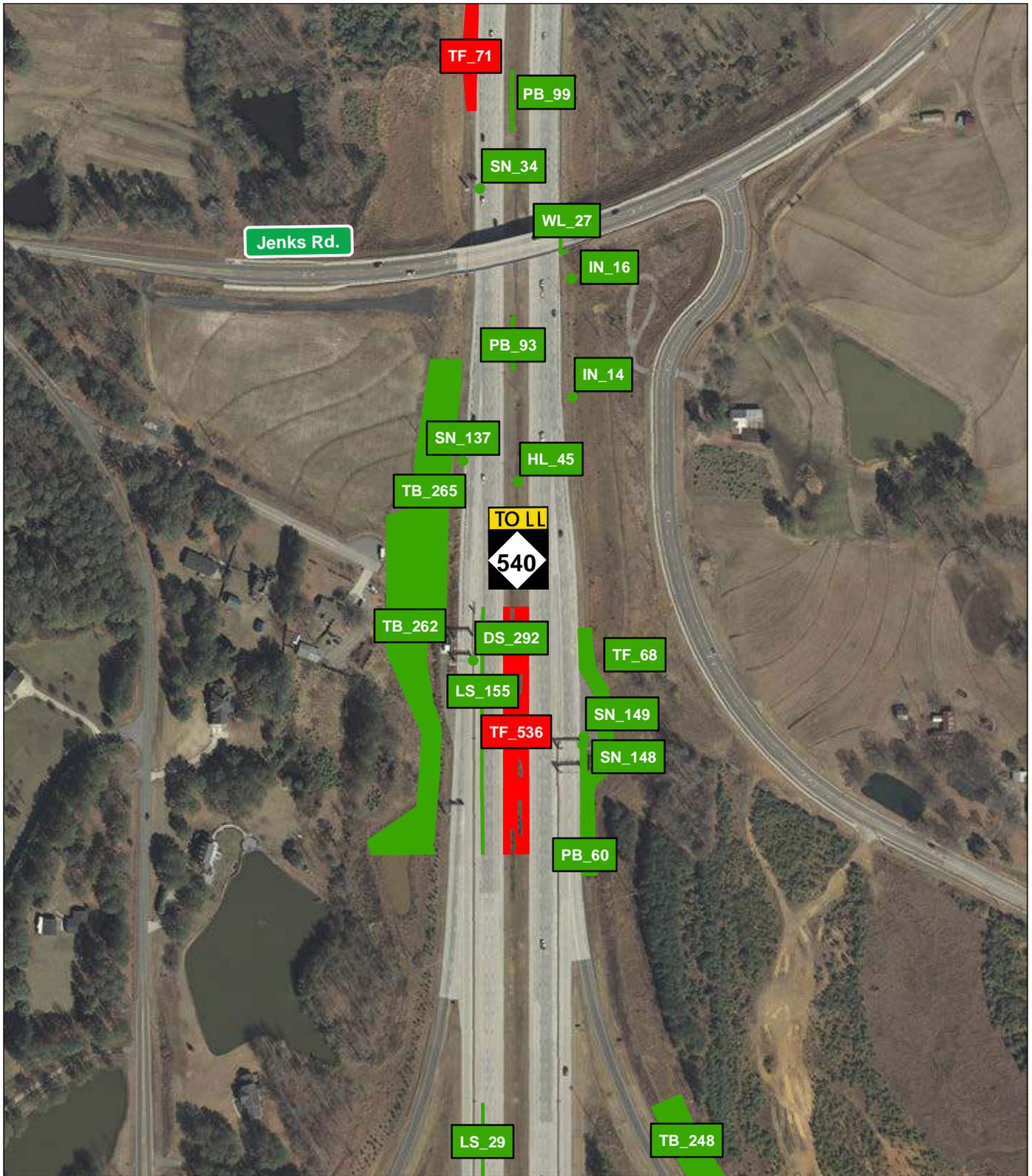


Legend

-  Passing Asset
-  Failing Asset

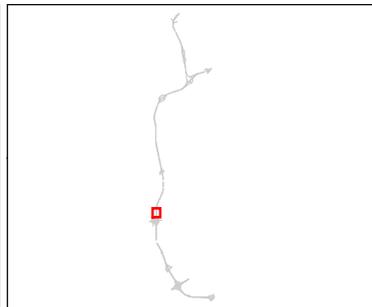


Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

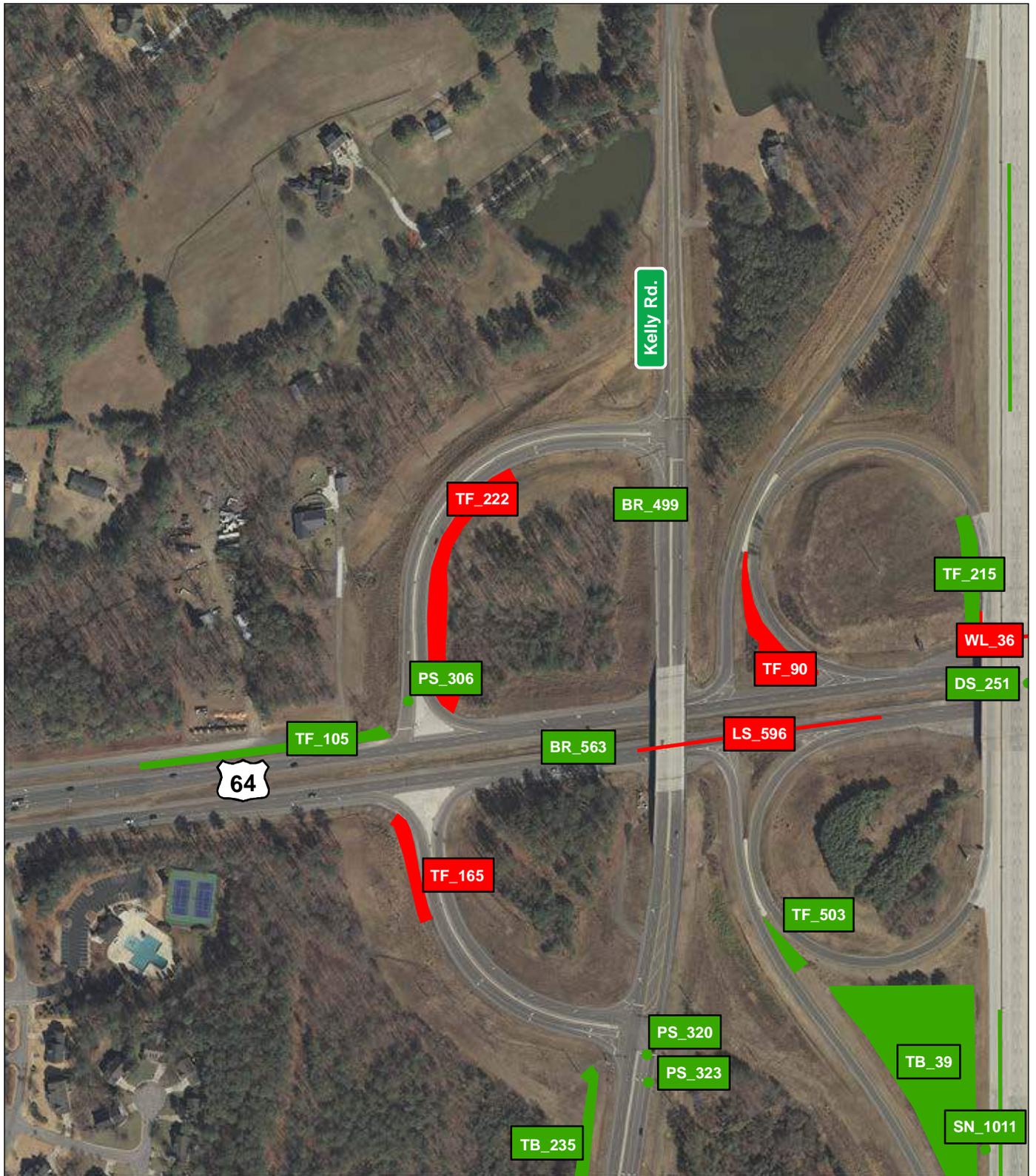


Legend

- Passing Asset
- Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

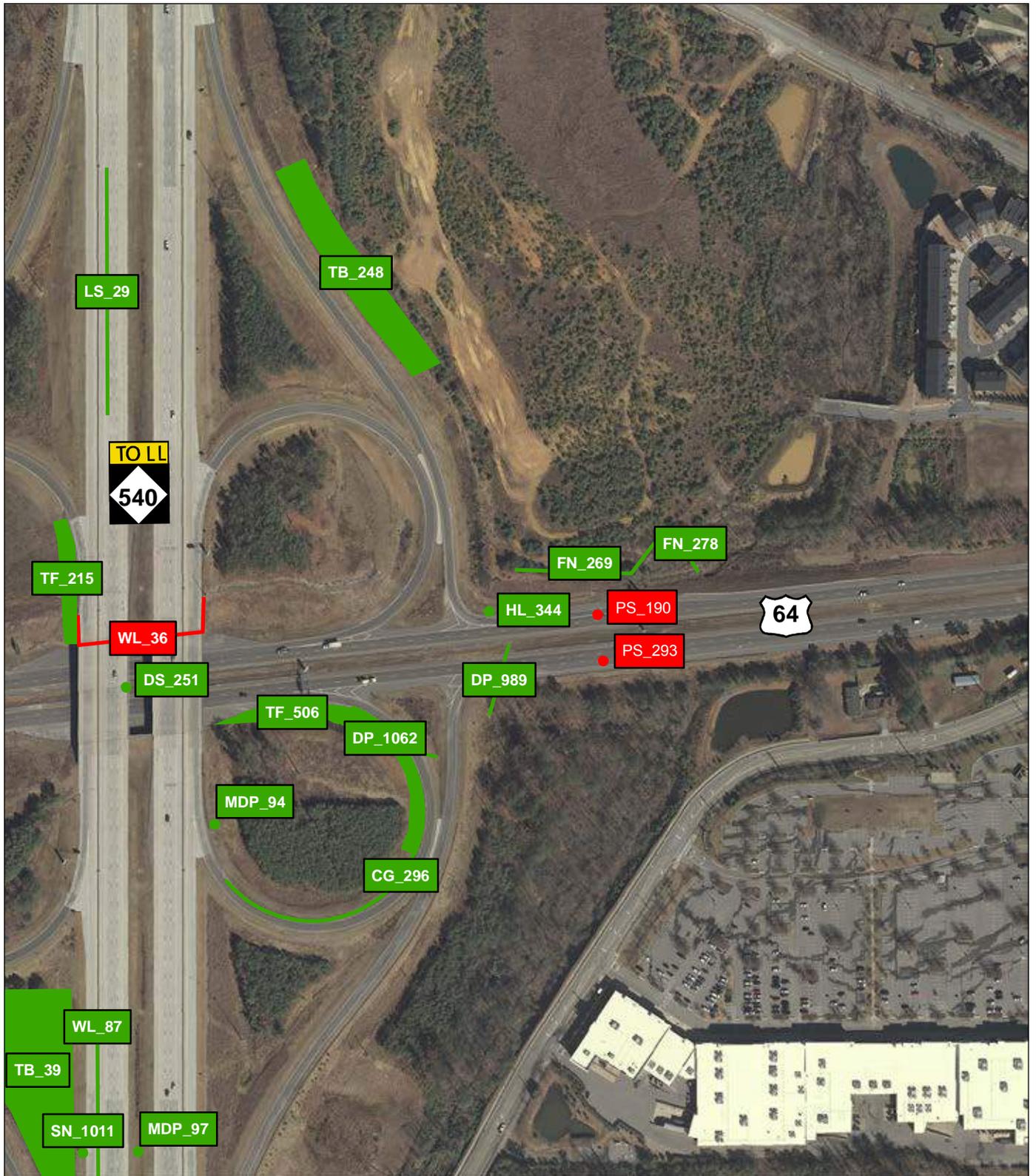


Legend

-  Passing Asset
-  Failing Asset

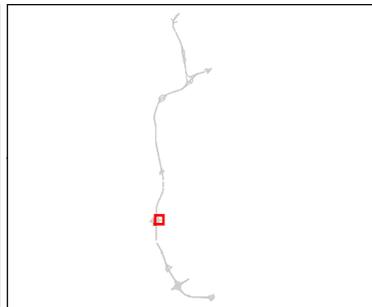


Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations



Legend

- Passing Asset
- Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

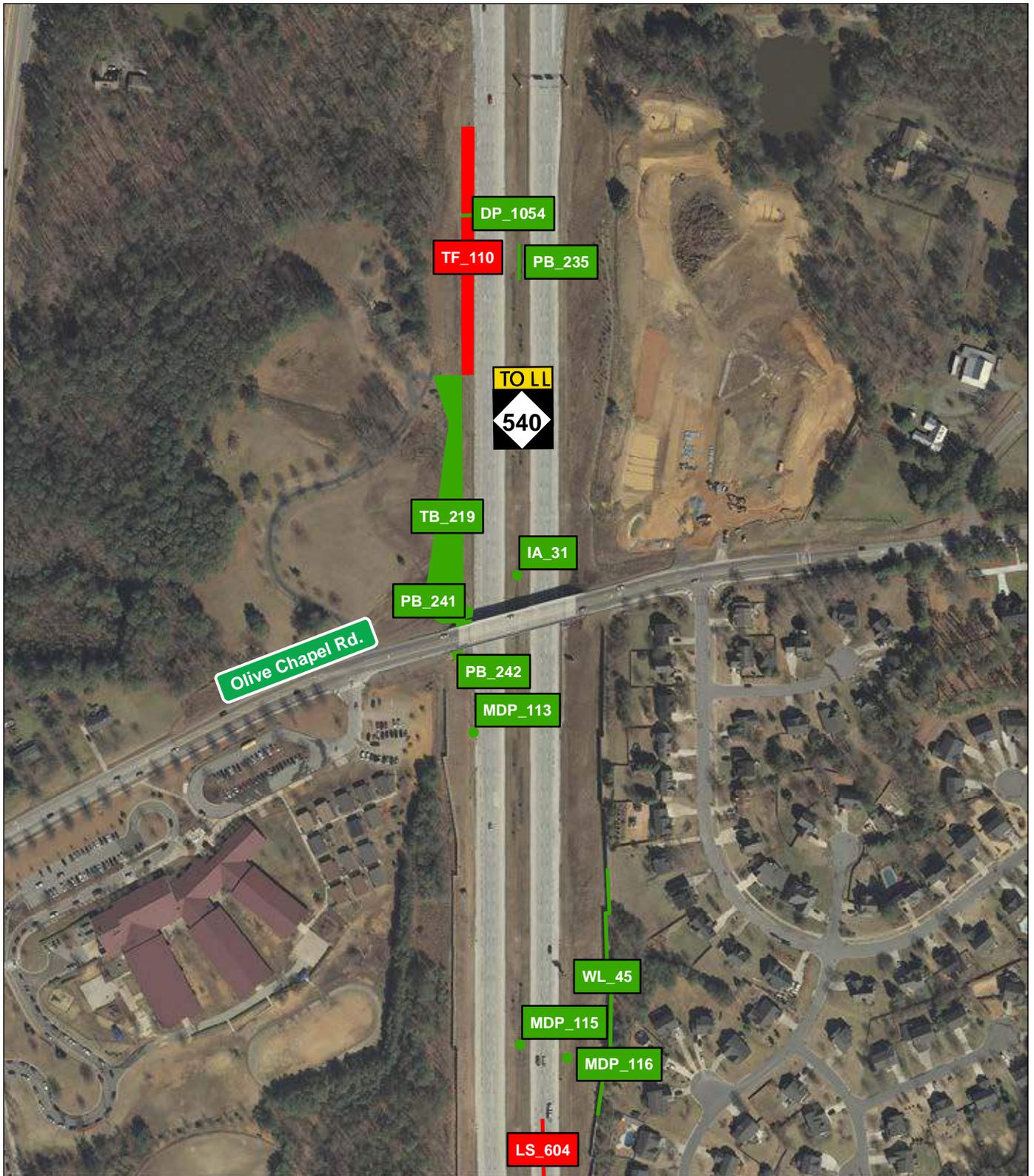


Legend

- Passing Asset
- Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

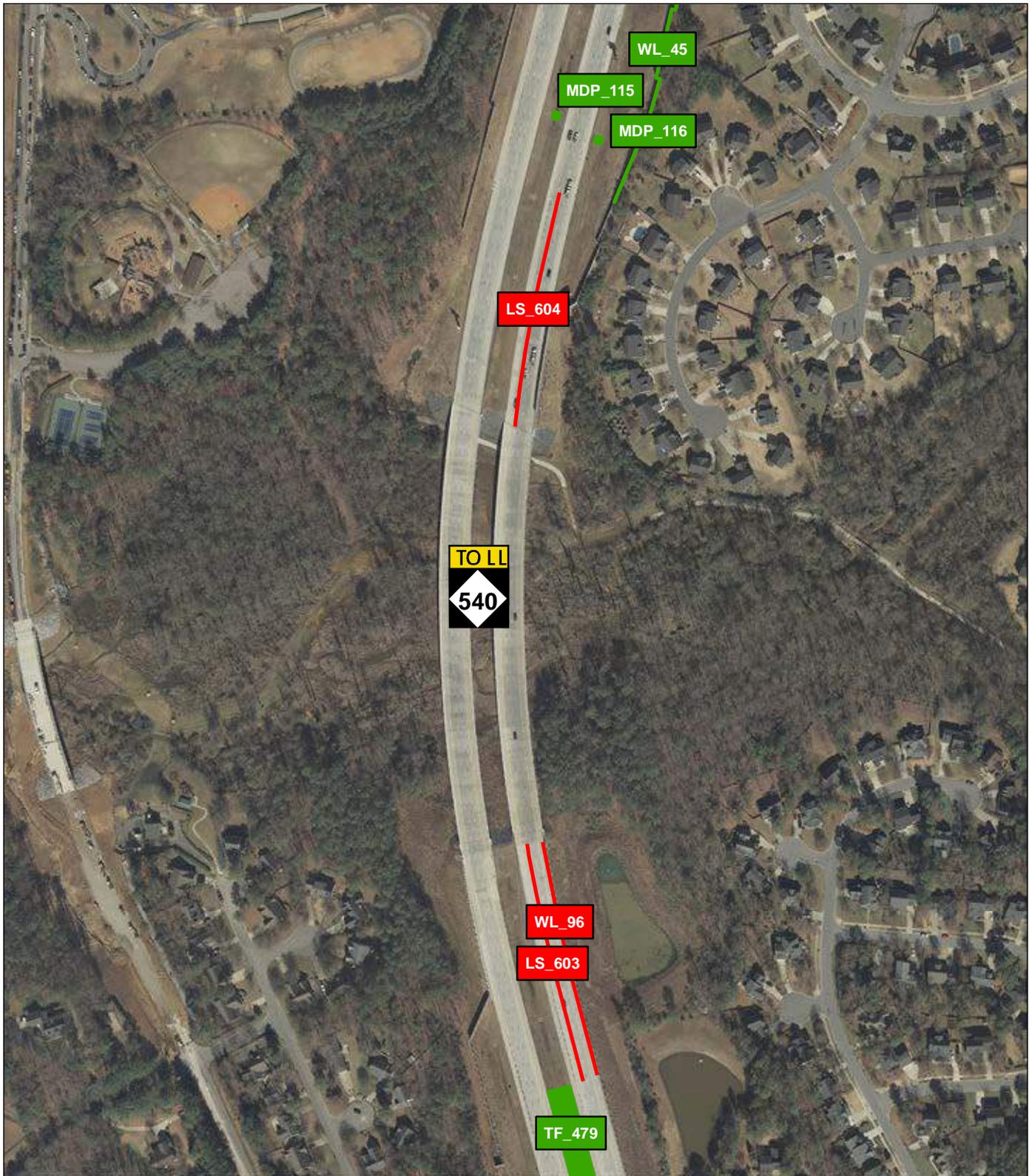


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

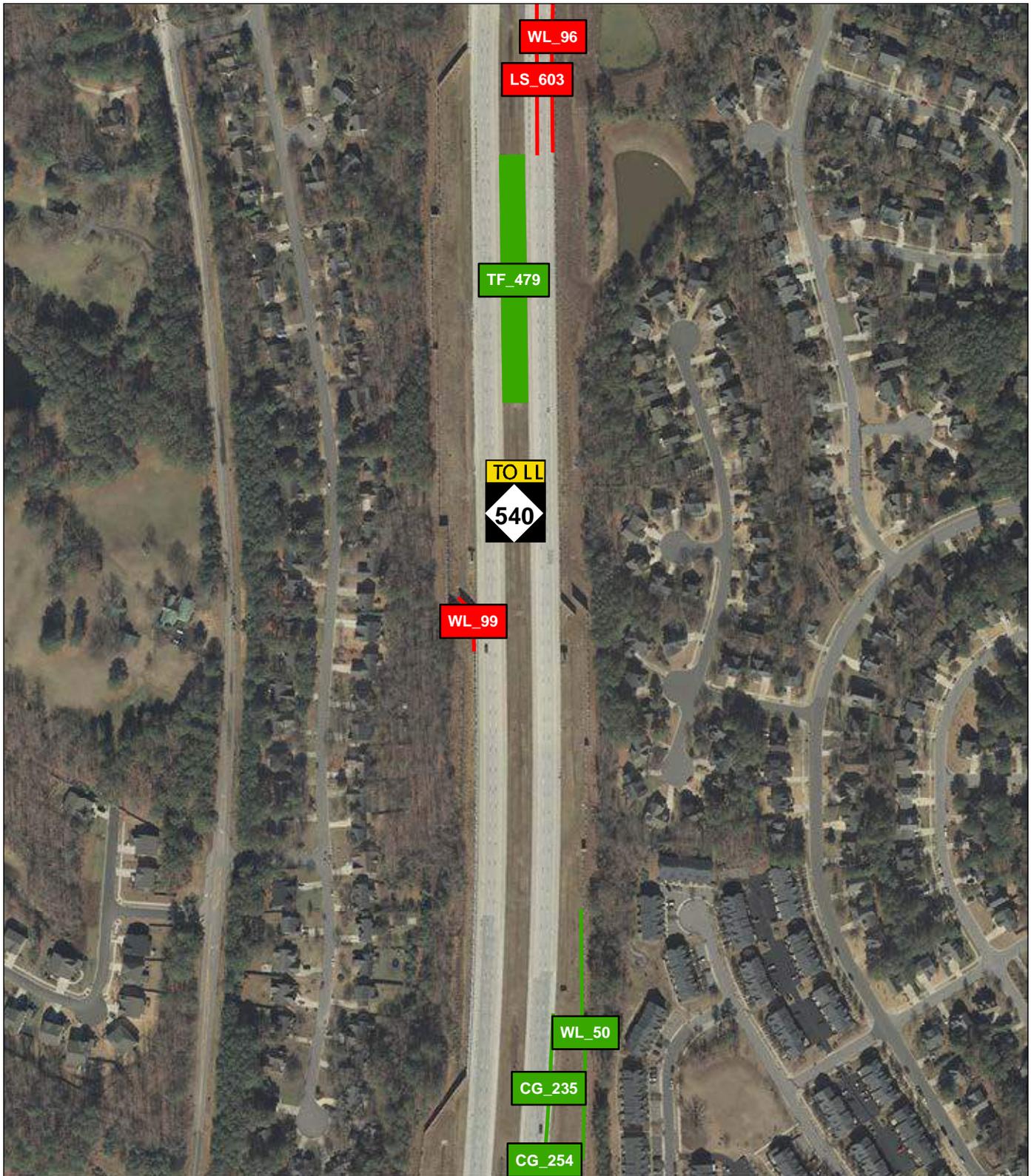


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

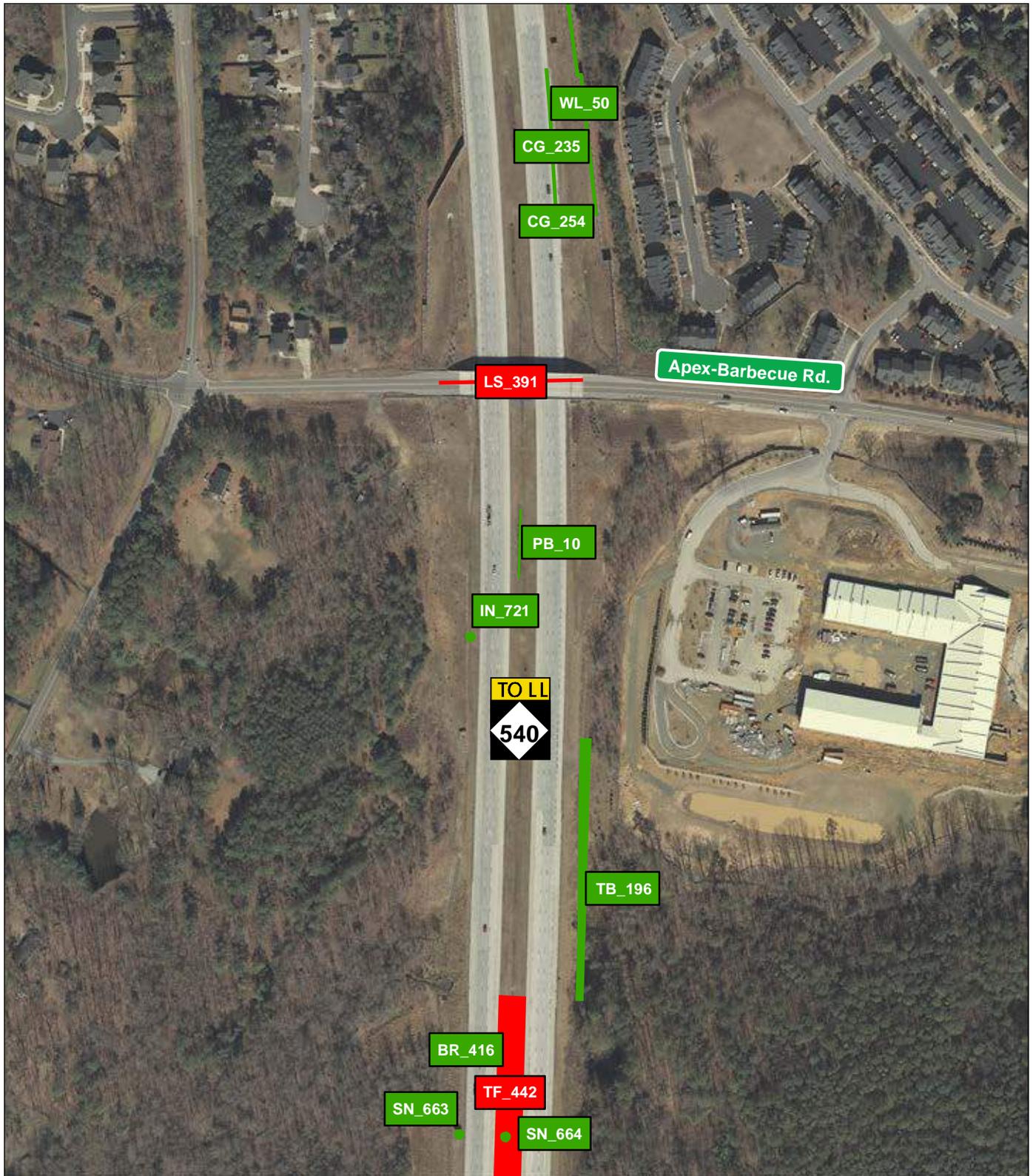


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

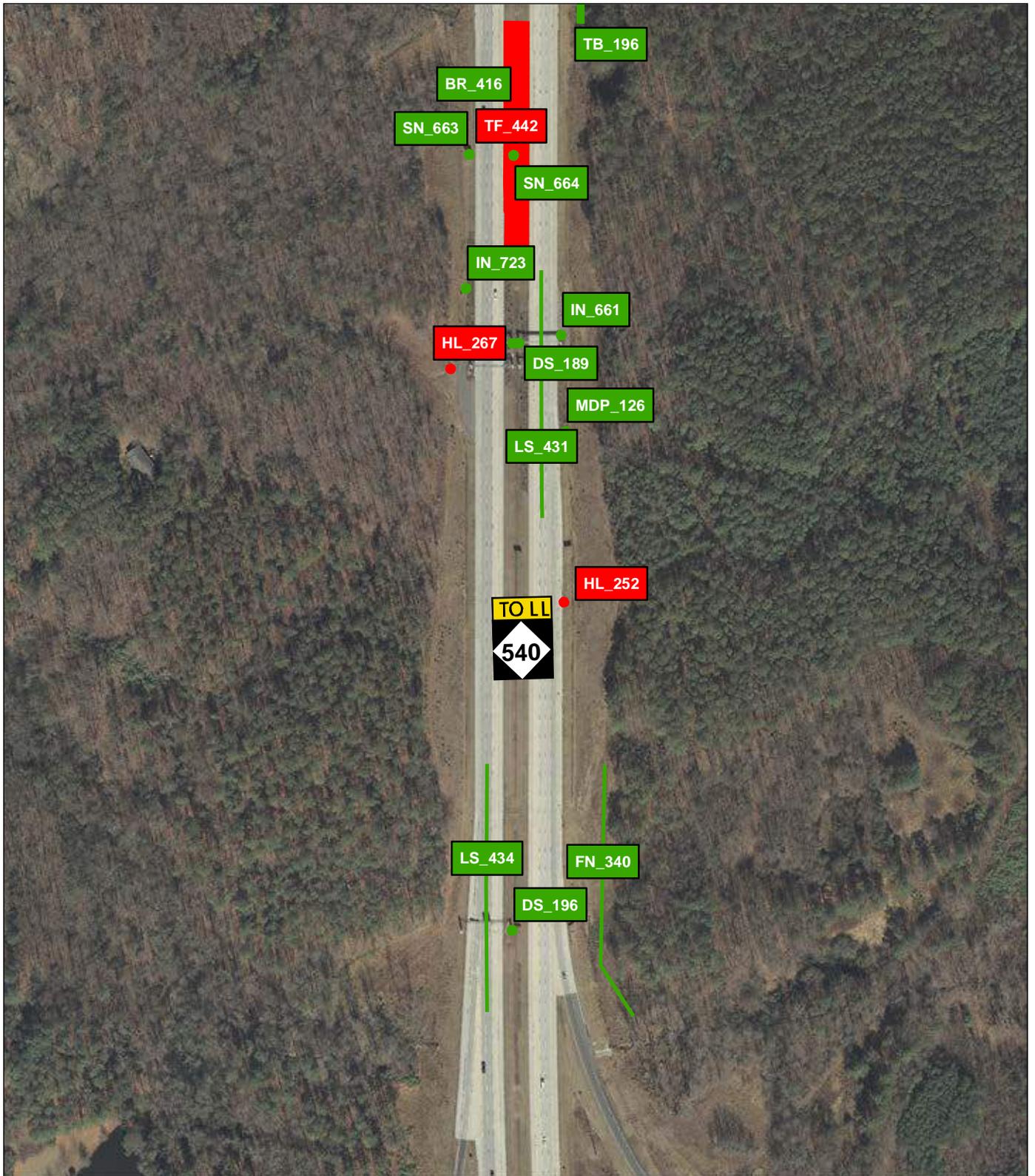


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

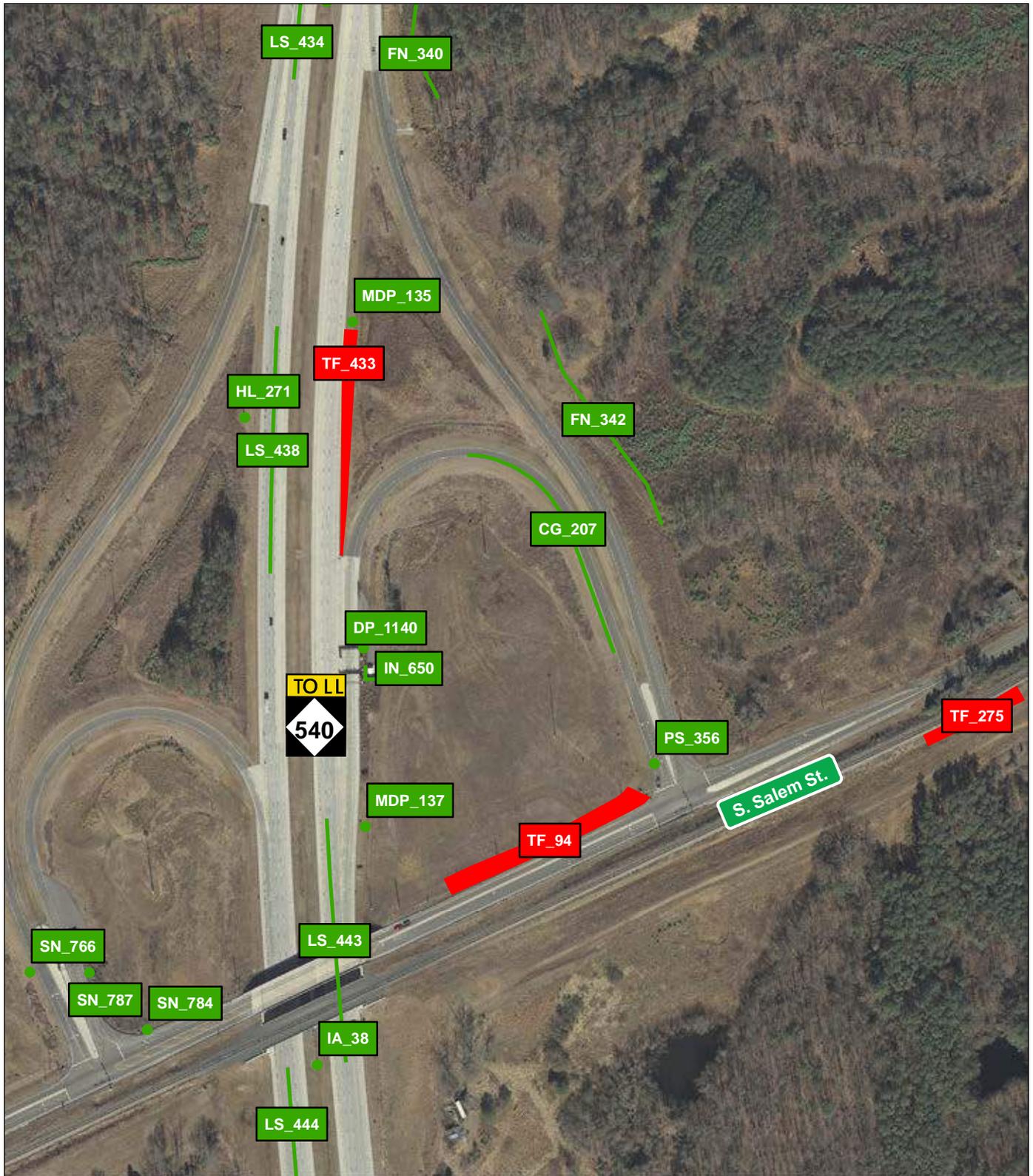


Legend

-  Passing Asset
-  Failing Asset

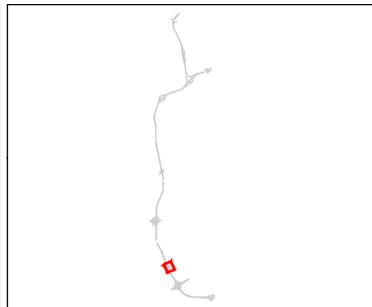


Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

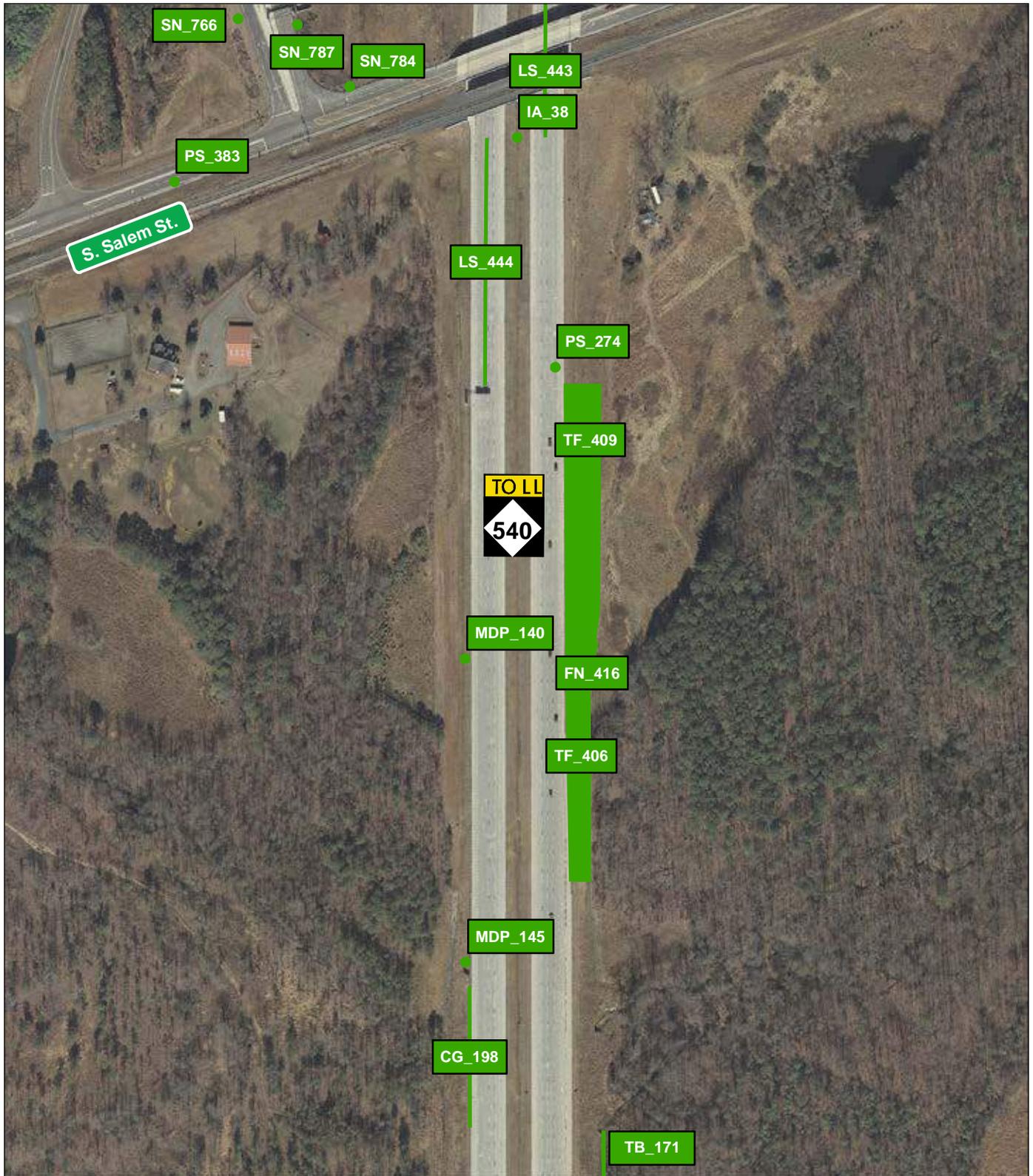


Legend

- Passing Asset
- Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

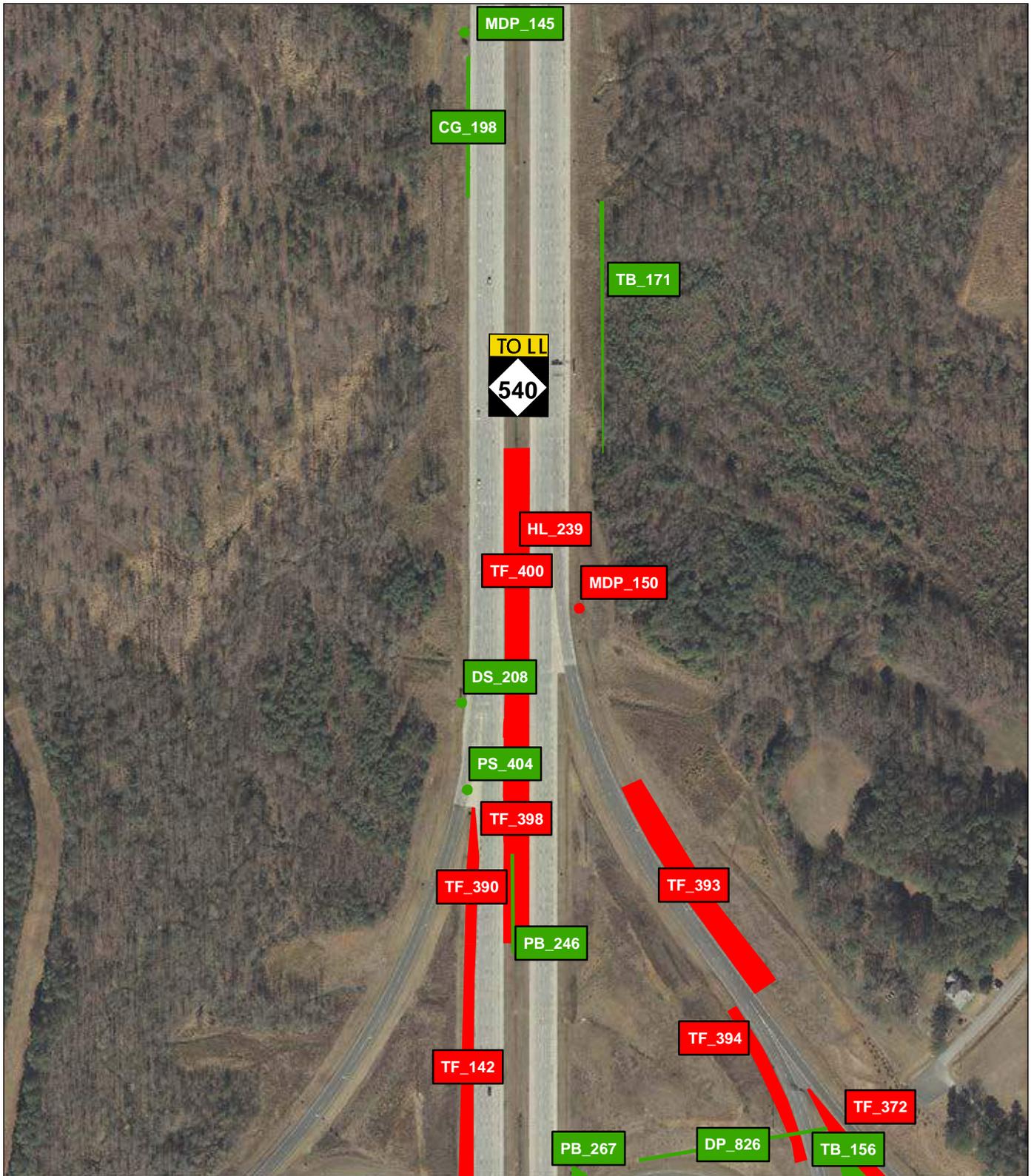


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

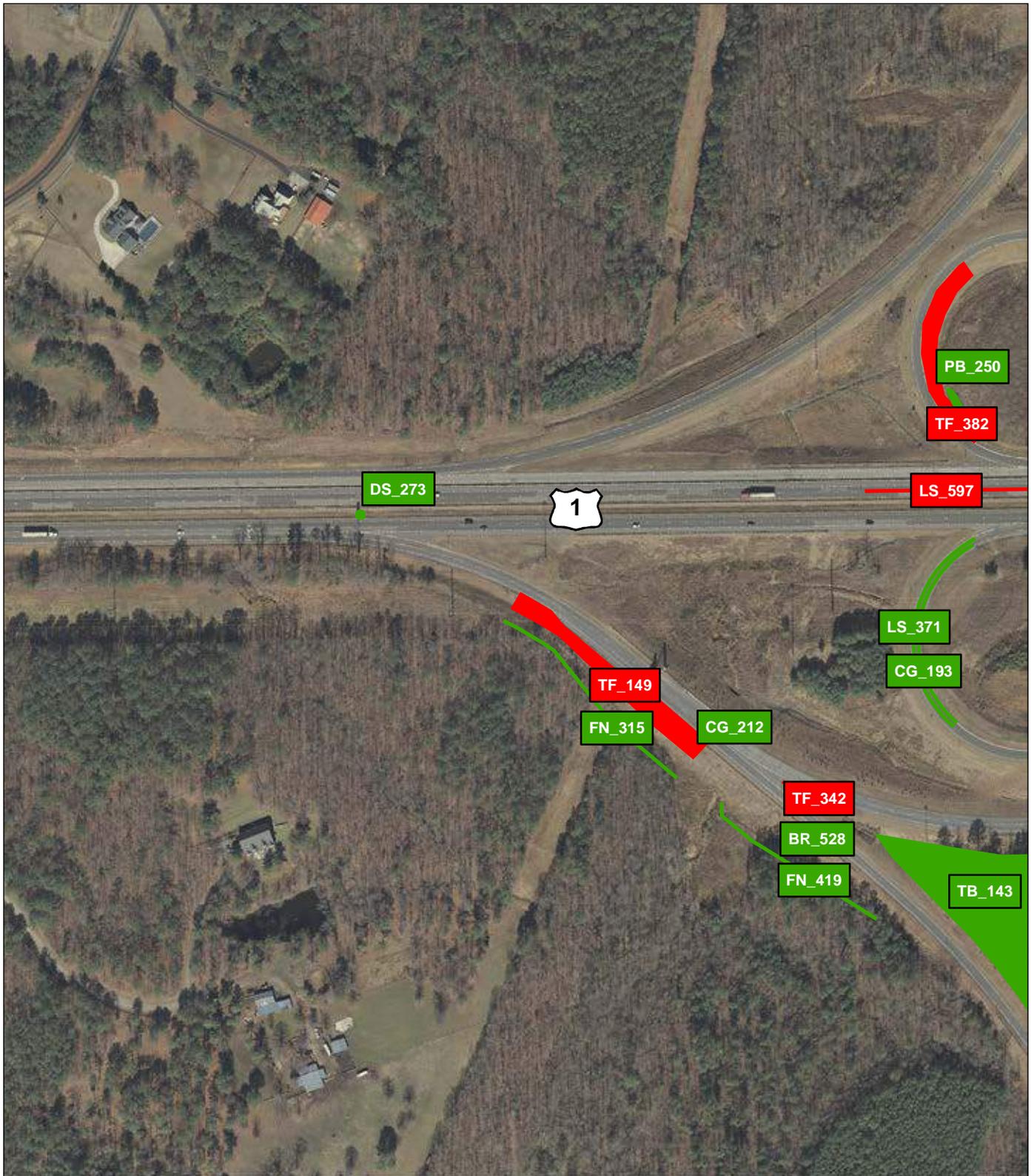


Legend

- Passing Asset
- Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

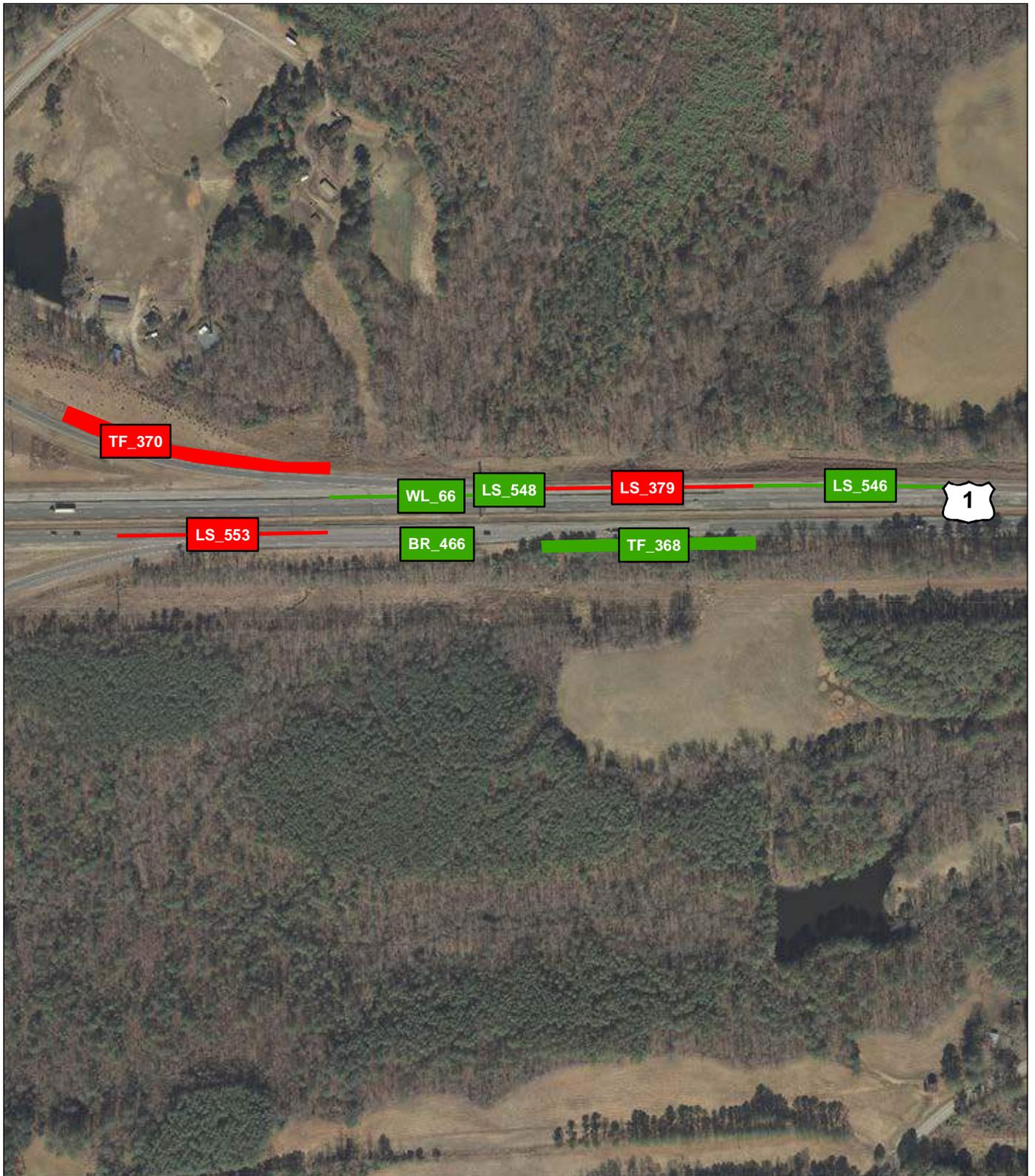


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

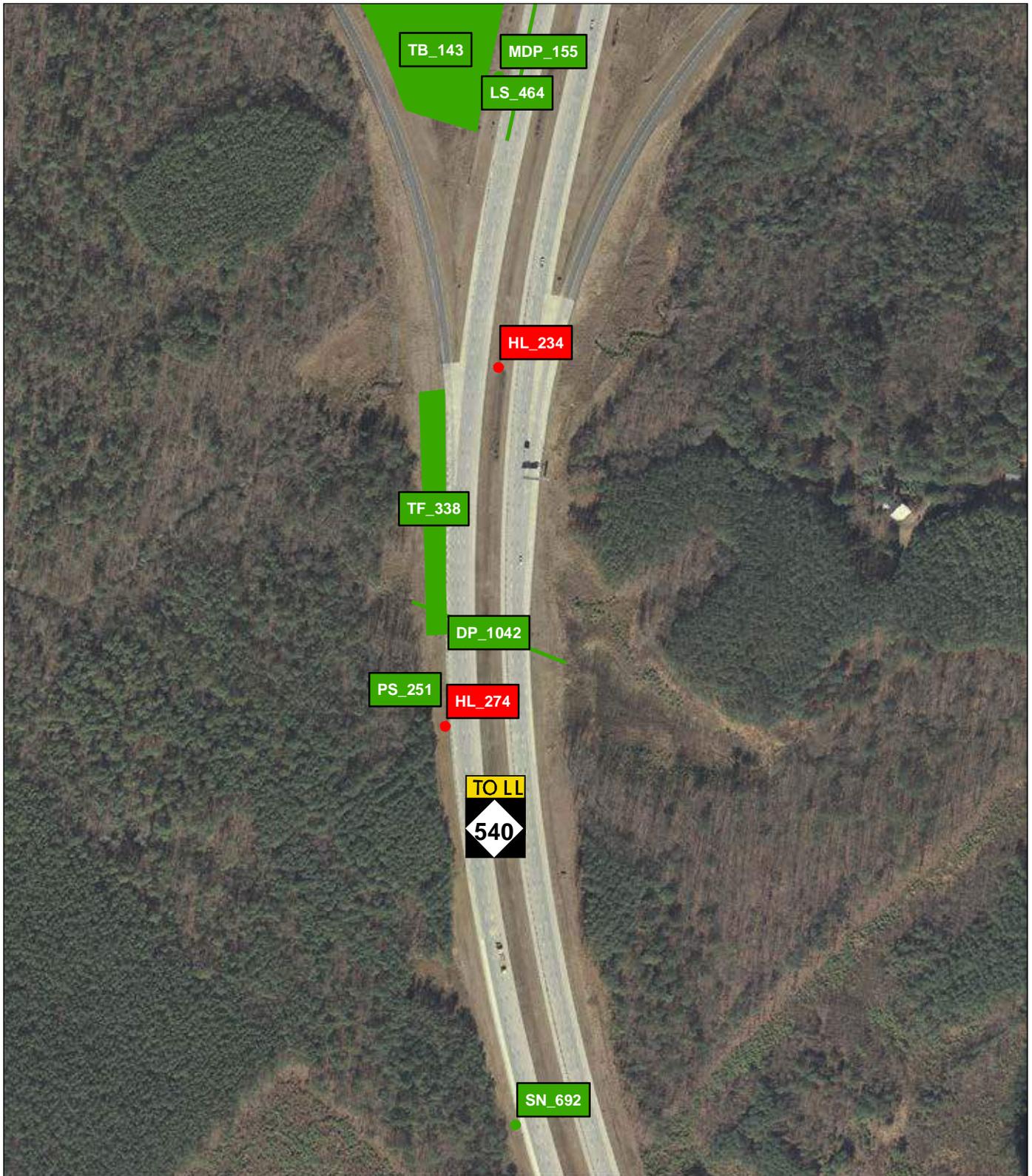


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

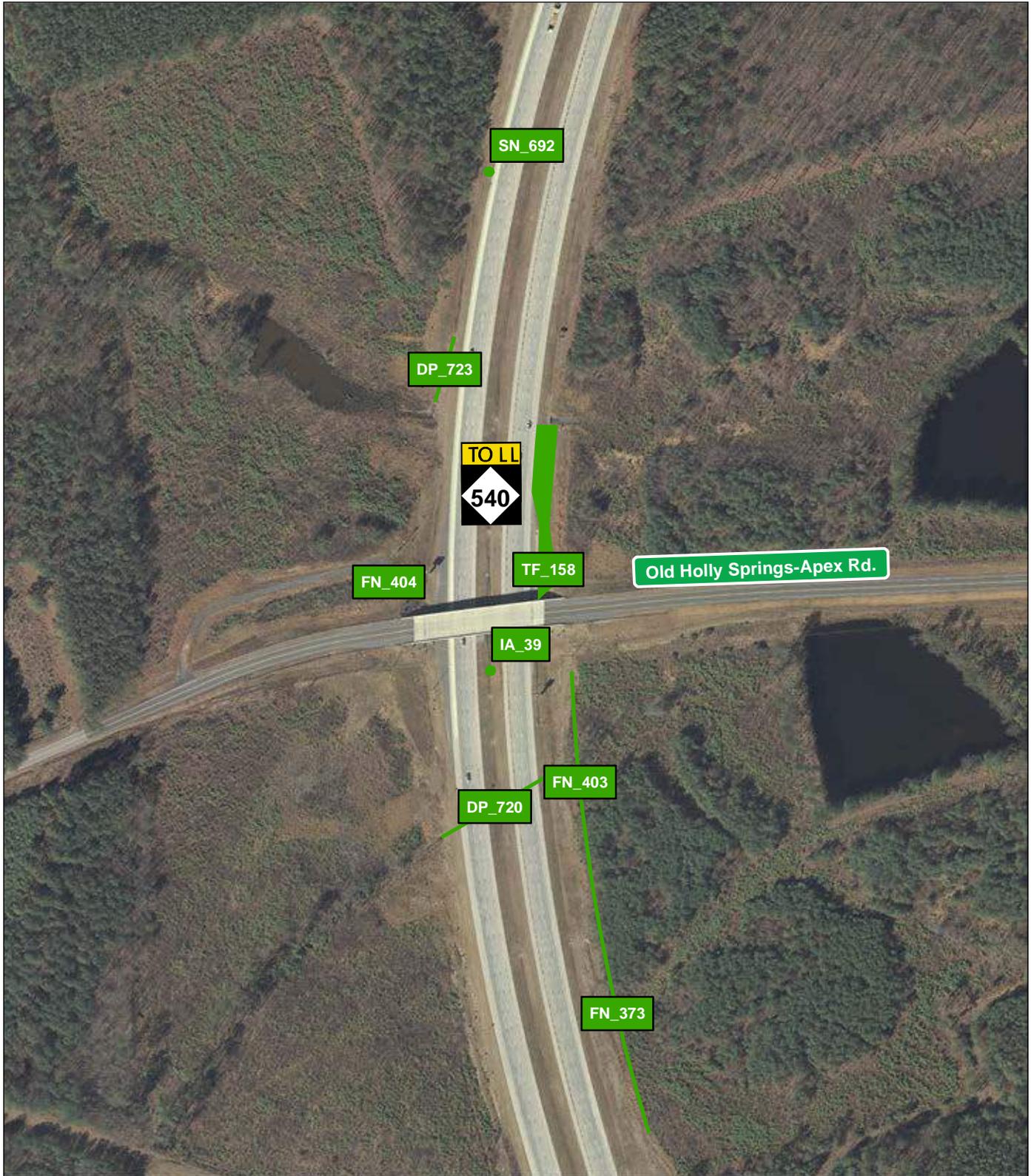


Legend

-  Passing Asset
-  Failing Asset

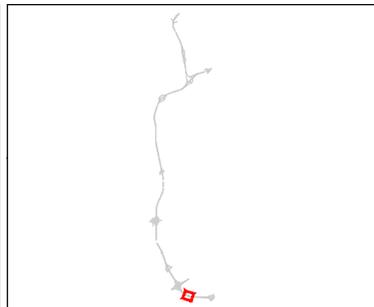


Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

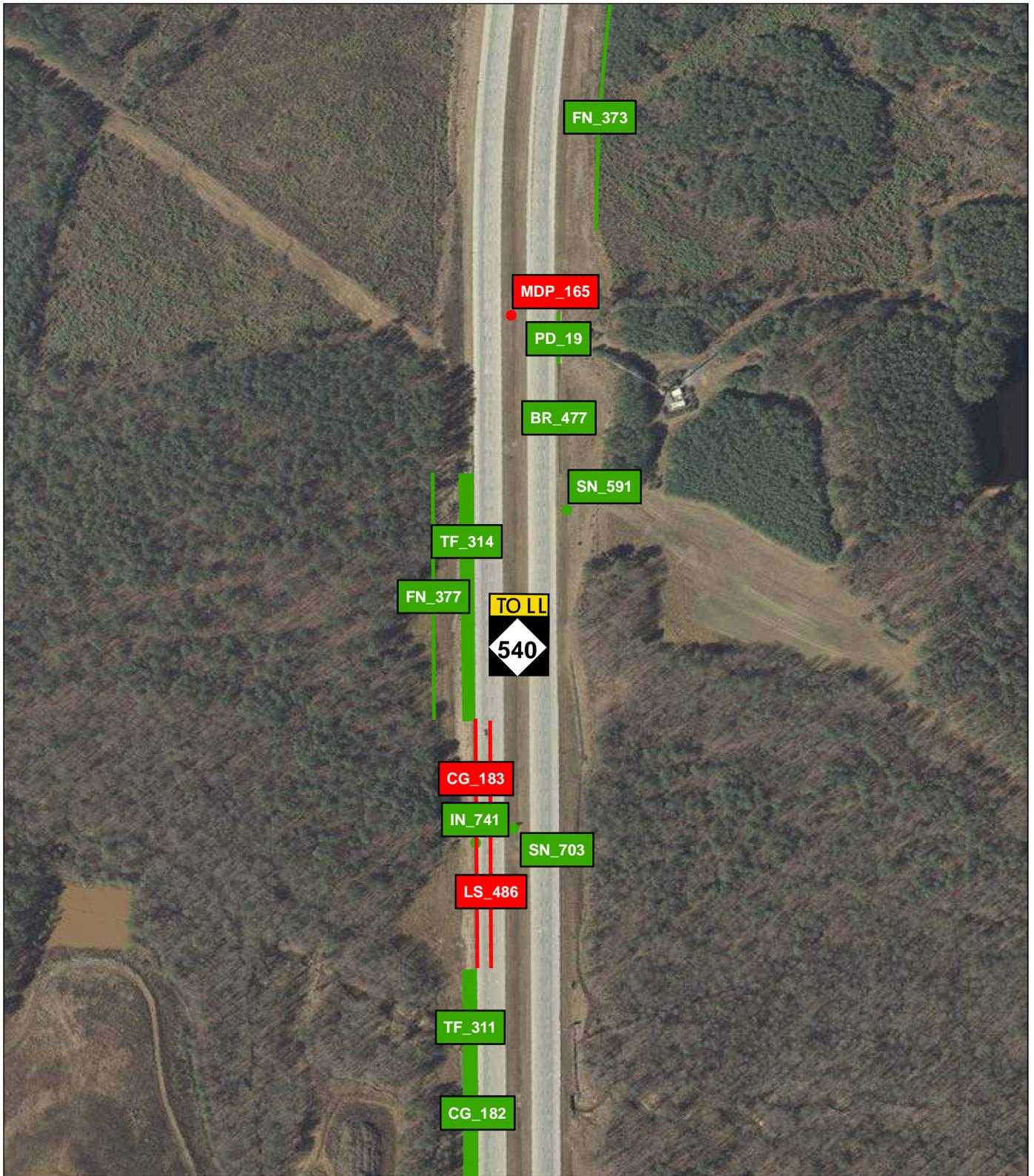


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

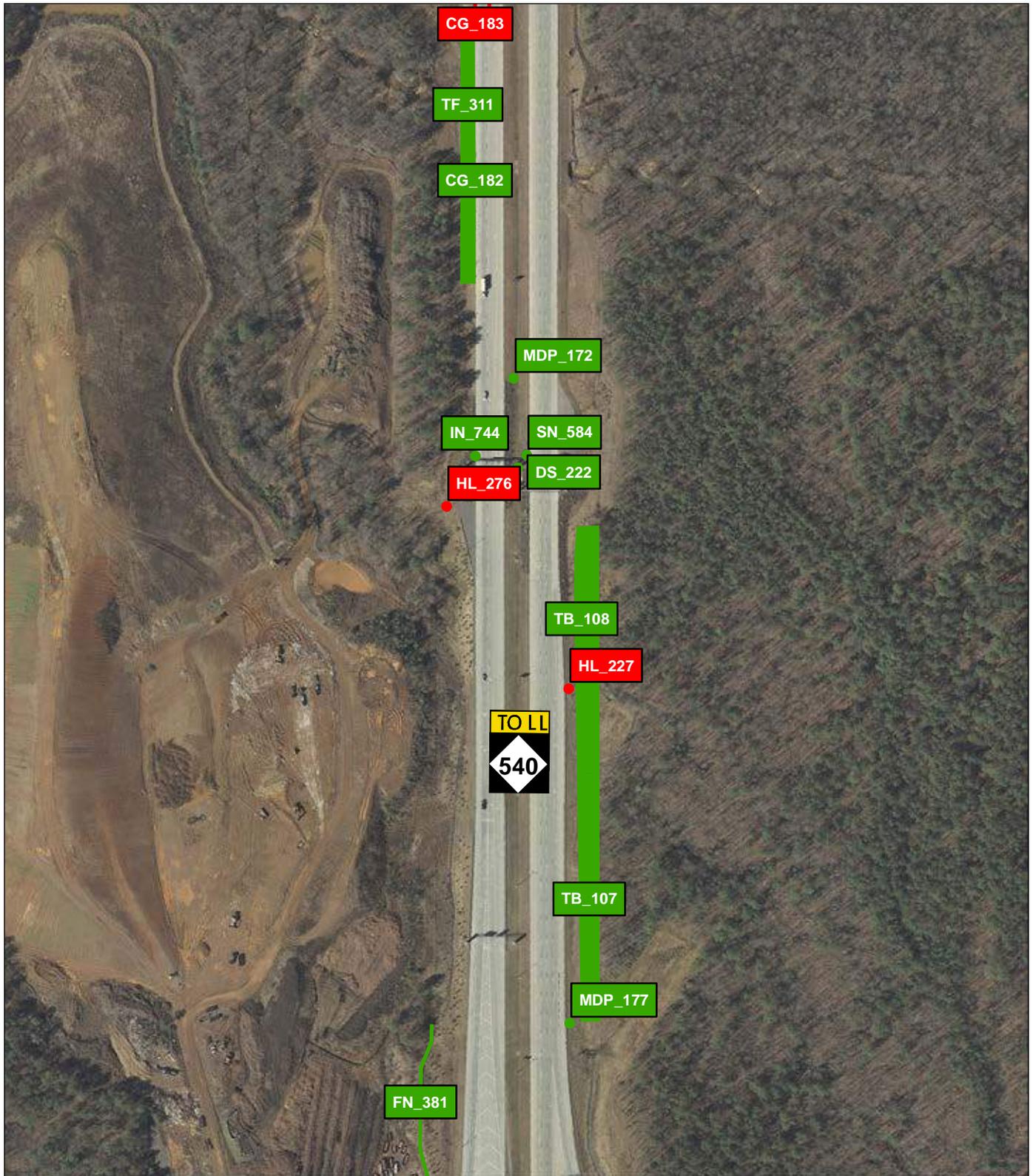


Legend

- Passing Asset
- Failing Asset

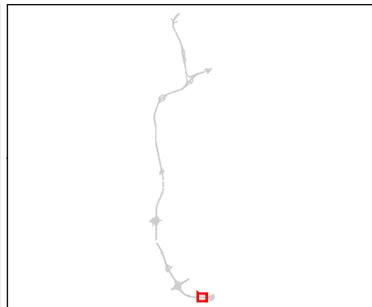


Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

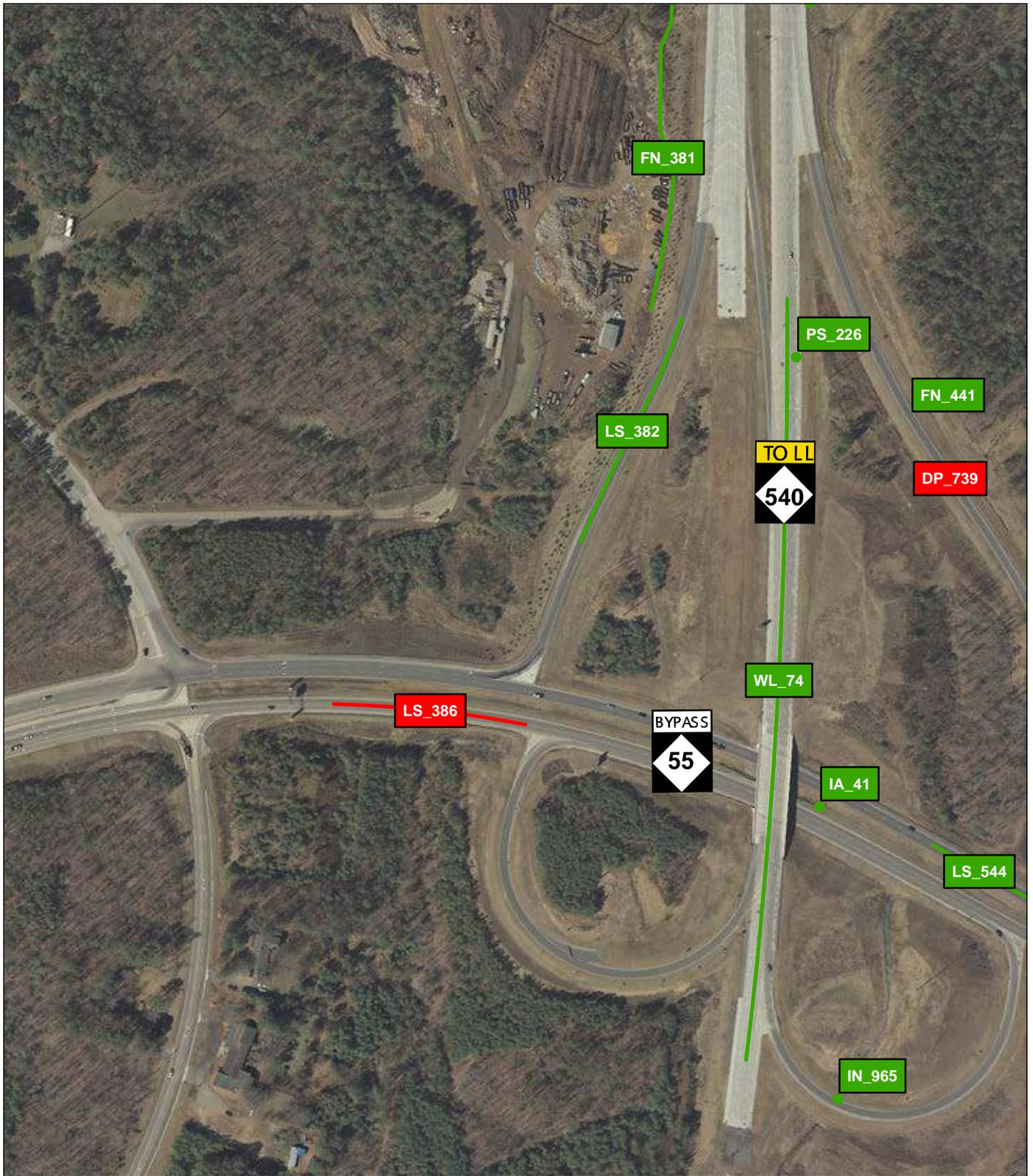


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset

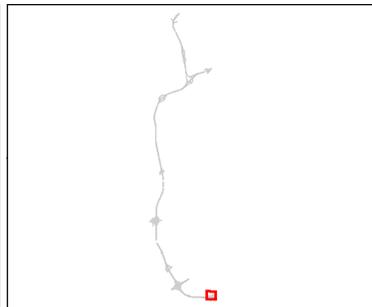


Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

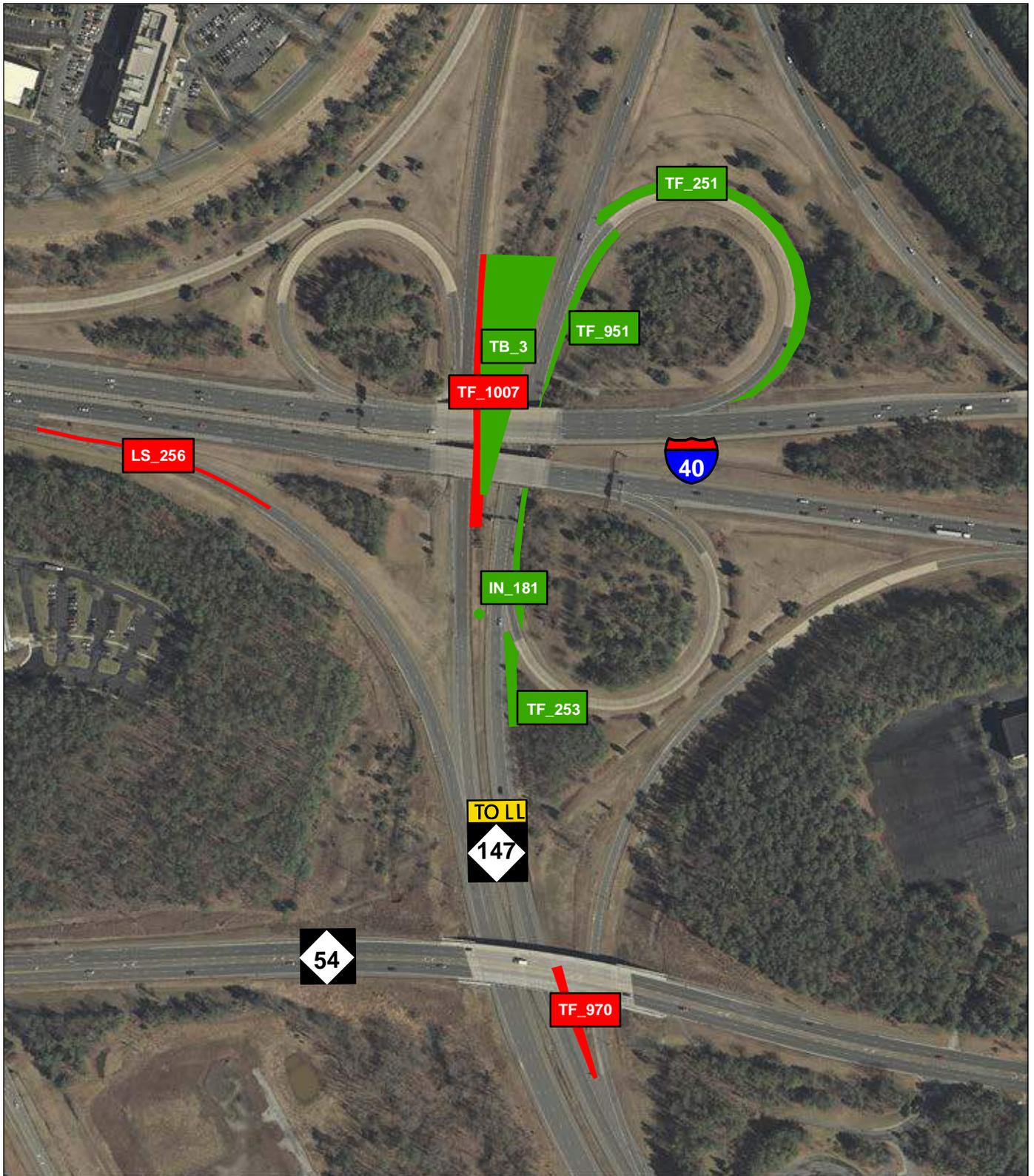


Legend

- Passing Asset
- Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

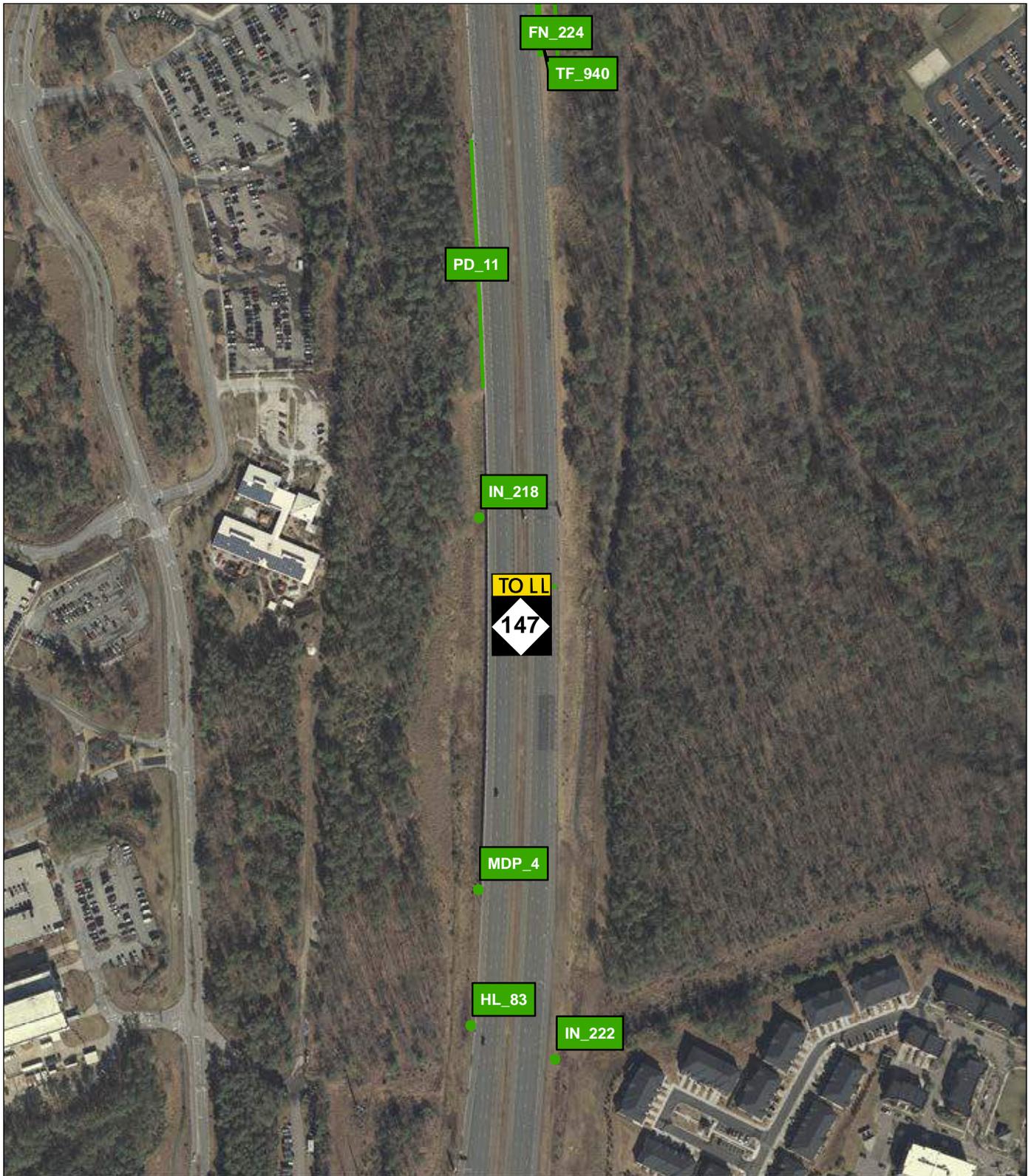


Legend

-  Passing Asset
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Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

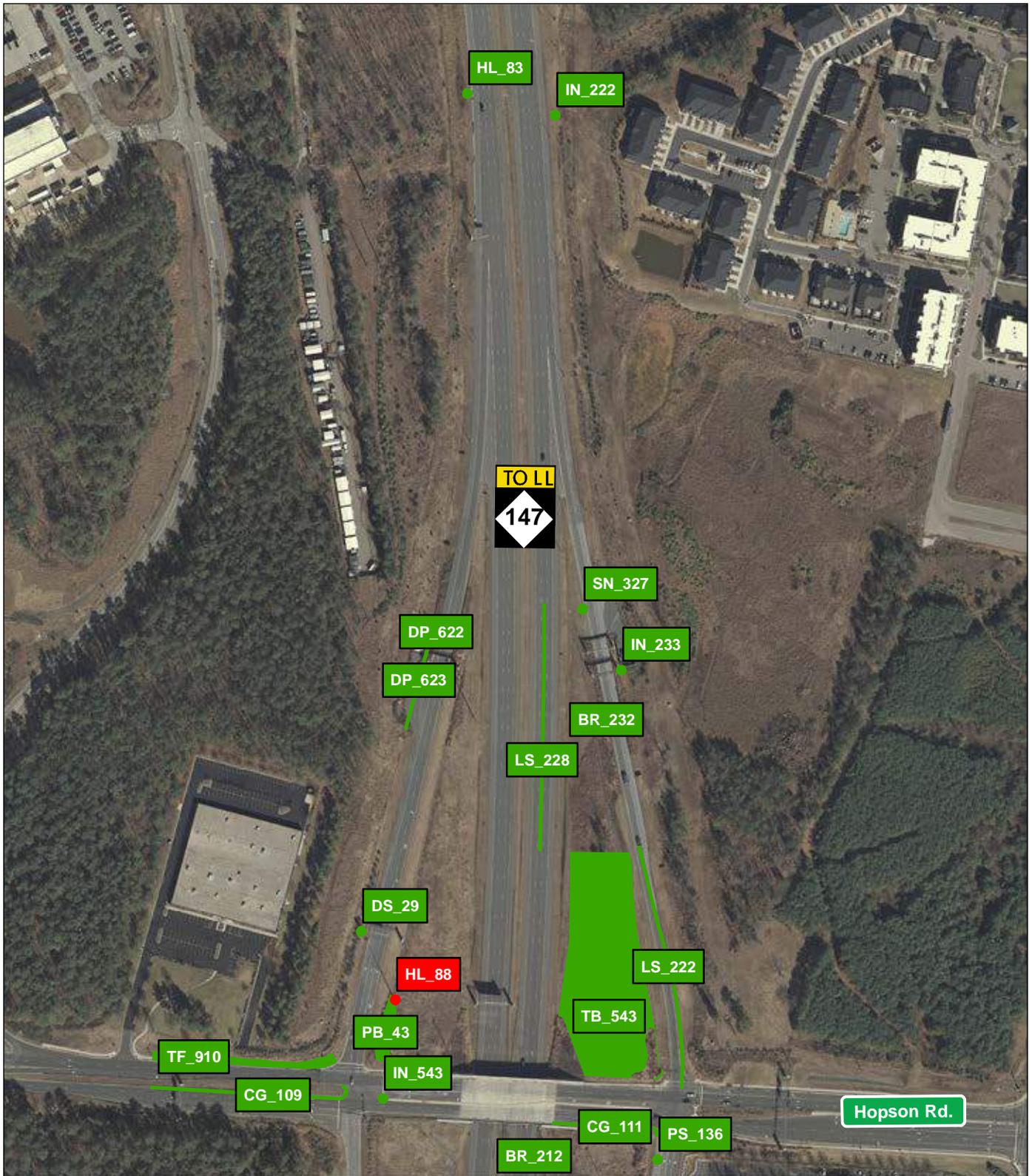


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

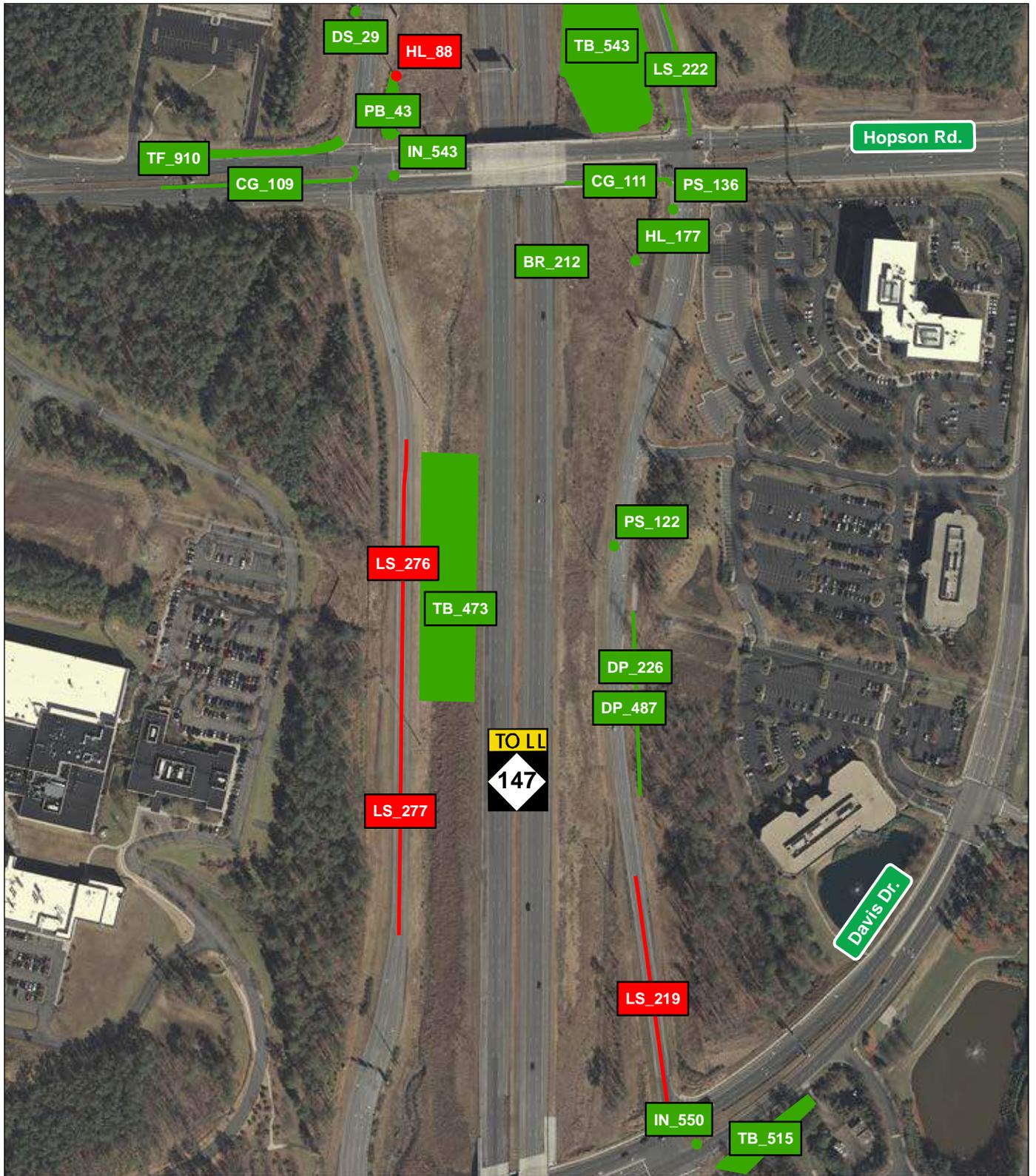


Legend

-  Passing Asset
-  Failing Asset

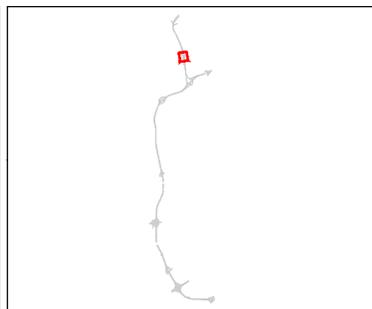


Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

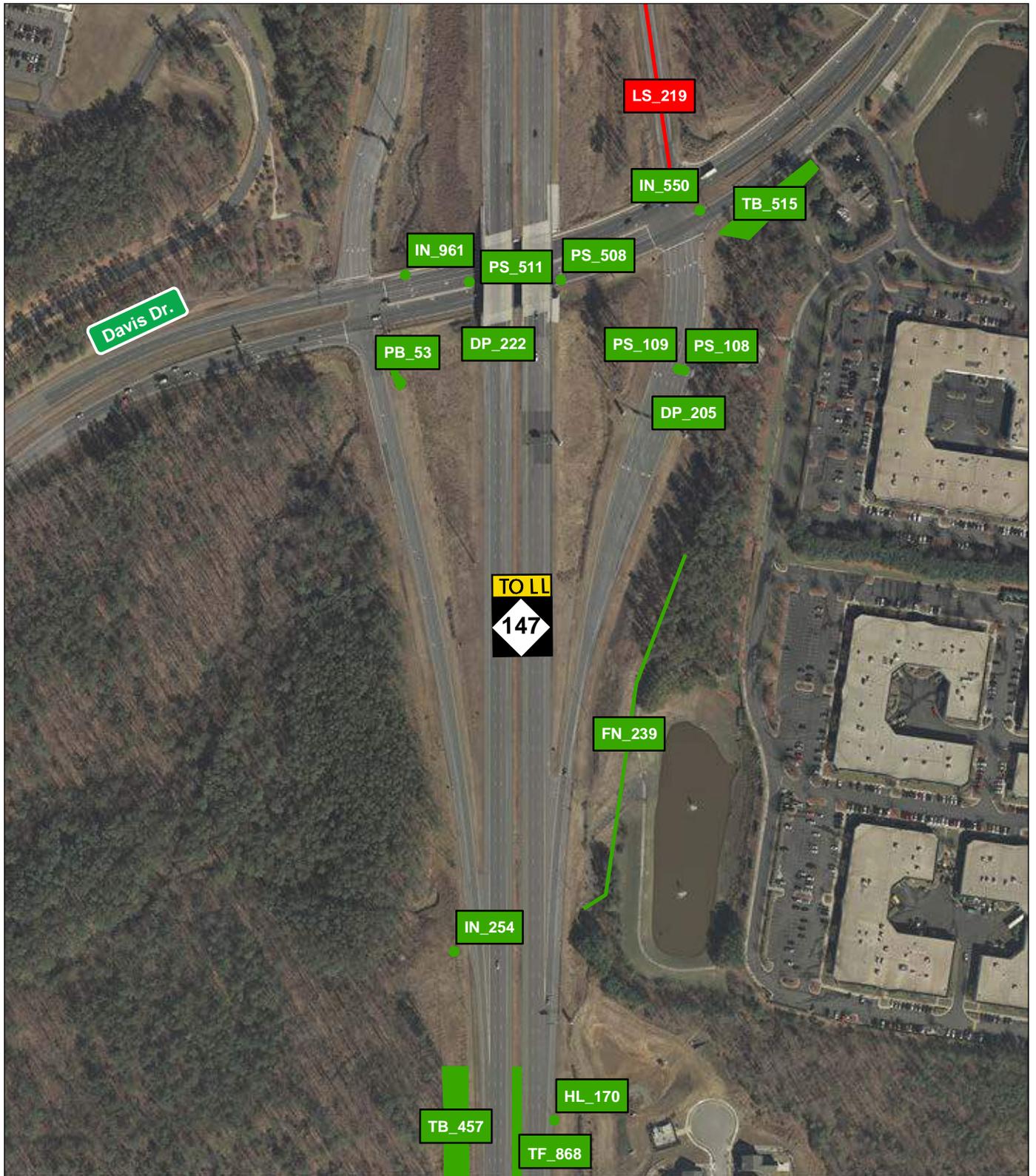


Legend

- Passing Asset
- Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

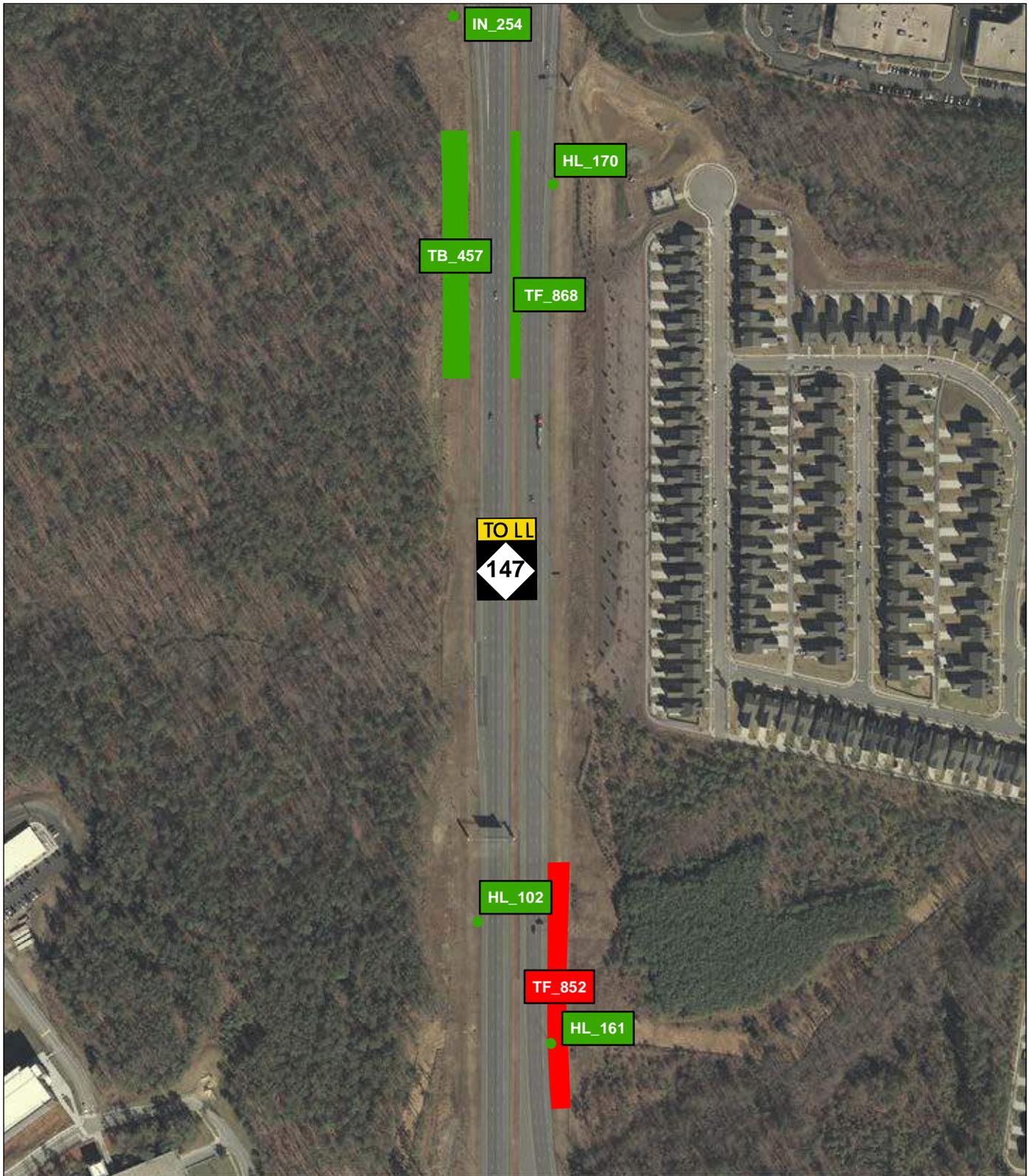


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations

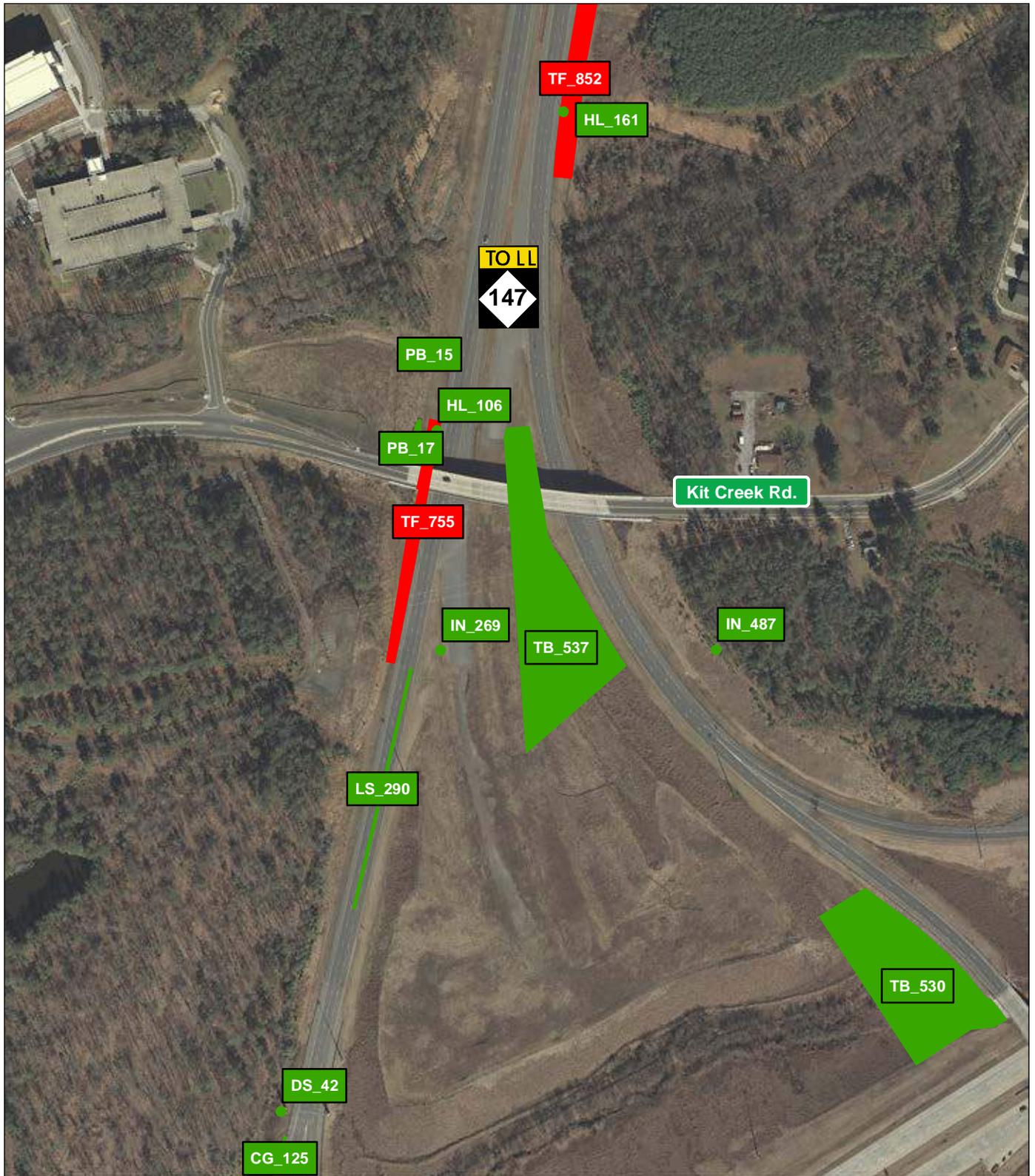


Legend

-  Passing Asset
-  Failing Asset



Appendix A: Triangle Expressway 2015 Third Quarter Asset Assessment Locations



Legend

-  Passing Asset
-  Failing Asset



Appendix B

Triangle Expressway 2015 Third Quarter Table Results of Assets Failing MRP

Appendix B: Triangle Expressway 2015 Third Quarter Table Results of Assets Failing MRP

Provided below are a series of tables outlining the existing failures that occurred throughout the facility. Assets are defined by an Inventory ID, which is a unique identifier given to each individual asset. The components that make up the Inventory ID are an asset specific prefix along with a number, such as LS_1. All assets and their respective prefixes are listed below:

Guardrail, Concrete Barrier and End Anchors (BR)..... 3
Curb and Gutter (CG) 4
Decorative Supports (DS)..... 5
Drainage Pipes (DP)..... 6
Misc. Drainage Structures (MDP)..... 7
Fence and Control of Access (FN) 8
Graffiti (GR) 9
Highway Lighting (HL) 10
Impact Attenuators (IA) 11
Inlets (IN)..... 12
Landscaping (PB) 13
Paved Lanes – Asphalt (LS)..... 14
Paved Lanes – Concrete (LS) 15
Paved Shoulders (LS)..... 16
Unpaved Shoulders (LS) 17
Front/Back Slopes (LS) 18
Unpaved Lateral and Outfall Ditches (LS) 19
Litter (LS) 20
Roadway Sweeping (LS) 21
Pavement Striping (LS)..... 22
Delineators (LS) 24
Paved Ditches (PD)..... 27
Pavement Words and Symbols (PS)..... 28
Signs (SN) 29
Tree and Brush (TB)..... 30
Turf Condition (TF) 31
MSE/Retaining Walls, Sound Barrier Walls and Screen Walls (WL)..... 41

The Inventory ID and GIS Reference Page number correspond to the provided map packets and allow for quick location of particular asset failures. Photos of failures were provided when applicable.

Guardrail, Concrete Barrier and End Anchors (BR)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Guardrail	BR_316	Twisted Block		A7, A8

Curb and Gutter (CG)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Valley	CG_128	Obstruction		A5
2	Valley	CG_183	Misalignment		A45, A46

Decorative Supports (DS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Drainage Pipes (DP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Drain	DP_12	Obstruction		A22
2	Lateral Pipe	DP_167	Obstruction		A5
3	Cross Pipe	DP_739	Obstruction		A47, A48

Misc. Drainage Structures (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Shoulder Drain	MDP_59	Obstruction		A21, A22
2	Shoulder Drain	MDP_88	Obstruction		A27
3	Shoulder Drain	MDP_150	Obstruction		A39
4	Shoulder Drain	MDP_165	Obstruction		A45

Fence and Control of Access (FN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Graffiti (GR)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Highway Lighting (HL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Single Roadway	HL_15	Functional Damage and Missing Parts		A21
2	High Mast	HL_88	Functional Damage	Not Available for Nighttime Failure	A53, A54
3	Single Roadway	HL_227	Functional Damage	Not Available for Nighttime Failure	A46
4	Double Roadway	HL_234	Functional Damage	Not Available for Nighttime Failure	A43
5	Double Roadway	HL_239	Functional Damage	Not Available for Nighttime Failure	A39
6	Single Roadway	HL_252	Functional Damage	Not Available for Nighttime Failure	A36
7	Single Roadway	HL_267	Functional Damage	Not Available for Nighttime Failure	A36
8	Single Roadway	HL_274	Functional Damage	Not Available for Nighttime Failure	A43
9	Single Roadway	HL_276	Functional Damage	Not Available for Nighttime Failure	A46

Impact Attenuators (IA)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Gating Attenuator	IA_11	Functional Damage	Not Available for Nighttime Failure	A10, A11, A12

Inlets (IN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Landscaping (PB)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Paved Lanes – Asphalt (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Paved Lanes – Concrete (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Paved Shoulders (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete	LS_112	Paved Shoulder Joint		A15, A16
2	Asphalt	LS_219	Paved Shoulder Joint		A54, A55
3	Concrete	LS_486	Paved Shoulder Joint		A45

Unpaved Shoulders (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Front/Back Slopes (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Unpaved Lateral and Outfall Ditches (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Litter (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Roadway Sweeping (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_386	Roadway Sweeping		A47

Pavement Striping (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete	LS_463	Line Missing		A41
2	Asphalt	LS_596	Nighttime Line Visibility	Not Available for Nighttime Failure	A29

Pavement Markers (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_219	Marker Reflectivity	Not Available for Nighttime Failure	A54, A55
2	Asphalt	LS_256	Marker Reflectivity	Not Available for Nighttime Failure	A49
3	Asphalt	LS_276	Marker Reflectivity	Not Available for Nighttime Failure	A54
4	Asphalt	LS_277	Marker Reflectivity	Not Available for Nighttime Failure	A54
5	Concrete	LS_463	Marker Reflectivity, Missing Markers and Continous Markers		A41
6	Asphalt	LS_596	Marker Reflectivity	Not Available for Nighttime Failure	A29
7	Concrete	LS_603	Marker Reflectivity, Missing Markers and Continous Markers		A33, A34
8	Concrete	LS_604	Marker Reflectivity, Missing Markers and Continous Markers		A32, A33

Delineators (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete	LS_38	Nighttime Reflectivity and Missing Parts		A13
2	Concrete	LS_76	Nighttime Reflectivity and Missing Parts		A24
3	Concrete	LS_112	Nighttime Reflectivity and Missing Parts		A15, A16
4	Concrete	LS_335	Nighttime Reflectivity and Missing Parts		A9, A10, A11

Delineators (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Asphalt	LS_379	Nighttime Reflectivity and Missing Parts		A42
6	Asphalt	LS_386	Nighttime Reflectivity and Missing Parts		A47
7	Asphalt	LS_553	Nighttime Reflectivity	Not Available for Nighttime Failure	A42
8	Asphalt	LS_560	Nighttime Reflectivity and Missing Parts		A41
9	Asphalt	LS_597	Nighttime Reflectivity and Missing Parts		A40, A41

Delineators (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
10	Asphalt	LS_598	Nighttime Reflectivity and Missing Parts		A41
11	Asphalt	LS_391	Nighttime Reflectivity and Missing Parts		A35

Paved Ditches (PD)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Pavement Words and Symbols (PS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Right Turn	PS_190	Nighttime Reflectivity	Not Available for Nighttime Failure	A30
2	Merge Left	PS_293	Nighttime Reflectivity	Not Available for Nighttime Failure	A30

Signs (SN)

#	Sign Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Tree and Brush (TB)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Turf	TF_45	Bareground		A22, A23
2	Turf	TF_57	Bareground		A22
3	Turf	TF_71	Bareground		A27, A28
4	Turf	TF_79	Bareground		A22

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Turf	TF_90	Bareground		A29
6	Turf	TF_94	Bareground		A37
7	Turf	TF_110	Bareground		A31, A32
8	Turf	TF_142	Bareground		A39, A41

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
9	Turf	TF_149	Bareground		A40
10	Turf	TF_165	Bareground		A29
11	Turf	TF_222	Bareground		A29
12	Turf	TF_244	Bareground		A41

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
13	Turf	TF_275	Bareground		A37
14	Turf	TF_342	Bareground		A40, A41
15	Turf	TF_370	Bareground		A41, A42
16	Turf	TF_372	Bareground		A39, A41

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
17	Turf	TF_376	Bareground		A41
18	Turf	TF_382	Bareground		A40, A41
19	Turf	TF_390	Bareground		A39, A41
20	Turf	TF_393	Bareground		A39, A41

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
21	Turf	TF_394	Bareground		A39, A41
22	Turf	TF_398	Bareground		A39, A41
23	Turf	TF_400	Bareground		A39
24	Turf	TF_433	Bareground		A37

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
25	Turf	TF_442	Bareground		A35, A36
26	Turf	TF_536	Bareground		A28
27	Turf	TF_546	Bareground		A27
28	Turf	TF_551	Bareground		A26

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
29	Turf	TF_559	Bareground		A25
30	Turf	TF_592	Bareground		A21
31	Turf	TF_619	Bareground		A18
32	Turf	TF_659	Bareground		A41

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
33	Turf	TF_673	Bareground		A12, A13
34	Turf	TF_712	Bareground		A10
35	Turf	TF_755	Bareground		A57
36	Turf	TF_830	Bareground		A2

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
37	Turf	TF_852	Bareground		A56, A57
38	Turf	TF_970	Bareground		A49, A50
39	Turf	TF_1007	Bareground		A49

MSE/Retaining Walls, Sound Barrier Walls and Screen Walls (WL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Sound Wall	WL_36	Paint Scaling		A29, A30
2	Sound Wall	WL_63	Joint Separation		A41
3	Sound Wall	WL_96	Joint Separation and Paint Scaling		A33, A34

MSE/Retaining Walls, Sound Barrier Walls and Screen Walls (WL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
4	Sound Wall	WL_99	Joint Separation		A34